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The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

New Sewage Disposal Works at Tilbury.

The British Empire Exhibition (Nineteenth Notice).

Short Wave Directional Wireless.

100 Years of British Railways—No. IX.

The French Navy.

British Wire-Drawing and Wire-Working Machinery—No. VII.

The Treatment of Water Supplies.

20-Ton Wagons for Coal Traffic.

PUBLIC NOTICES

RAILWAY MATERIALS FOR SALE.

Sealed Tenders will be received by the Director of Army Contracts for the following RAILWAY MATERIAL :—

AT CATTERICK CAMP, YORKS :
4 Standard-gauge Locomotives and Spares.
3 Passenger Coaches (4-wheel) and Spares.
3 Covered Vans and Spares.
21 W.D. Wagons and Spares.
Permanent Way Material.
Miscellaneous Tools and Plant.

AT CHILWELL, NOTTS :
1 "Baldwin" Locomotive.

AT BRAMLEY, HANTS :
2 "Avonside" Locomotives.

AT WEEDON, NORTHANTS :
1 "Baldwin" Locomotive.

Forms of Tender and further information may be had on application to the DIRECTOR OF ARMY CONTRACTS (D.C. Sales), Caxton House West, Tothill-street, London, S.W. 1. 6754

The Director - General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1. REQUIRES :
1. POINT RODS.
2. SPRINGS, HELICAL and VOLUTE.
3. AXLE-BOXES, CAST STEEL.
4. AXLES, C. and W.
5. SCREW COUPLINGS and SHACKLES.
6. BUFFERS, &c.
7. TYRES for CARRIAGE and WAGON WHEELS.
Tenders due on the 5th September, 1924, for No. 1, and on the 12th September, 1924, for Nos. 2 to 5, and on the 16th September, 1924, for Nos. 6 and 7.
Tender forms obtainable from above. 6790

ROADS ENGINEERS.

Wanted for Road Schemes under Local Highway Authorities in Great Britain, a NUMBER of TEMPORARY ENGINEERS, ASSISTANT ENGINEERS, and JUNIOR ENGINEERING ASSISTANTS for temporary employment. Inclusive salaries within following limits according to works experience and qualifications :—
Engineers, £500 to £700.
Assistant Engineers, £300 to £400.
Junior Engineering Assistants, £150 to £200.
Preference will be given to men who have served in His Majesty's Forces.
Applications should be made immediately in writing to the ESTABLISHMENT OFFICER, Ministry of Transport, 6, Whitehall-gardens, S.W. 1, stating age, qualifications, experience, references, and in which district employment would be preferred. 6771

Applications are Invited for APPOINTMENT as ASSISTANT ENGINEER (Mechanical and Electrical), H.M. Office of Works, at a commencing salary of £350 p.a. plus bonus (at present equivalent to £377 p.a. in all). Two years' strict probation prior to confirmation of appointment. Age 22 to 35. Candidates must have served in His Majesty's Forces during the war and must be Corporate Members of the Institution of Civil Engineers or have passed an examination qualifying for such membership.
Experience in theory and practice of heating and ventilating, electrical engineering, specifications, and the use and properties of materials required.
Applications to be made in writing not later than 27th September, 1924, on a form to be obtained from the CHIEF ENGINEER, H.M. Office of Works, Caxton House, Tothill-street, Westminster, S.W. 1. 6798

Overseer Required by the GOVERNMENT of HONG KONG, for the PUBLIC WORKS DEPARTMENT, for three years, with possible extension. Salary £320-£10-£360 a year, payable locally in dollars at the Government rate of exchange, at present fixed at 2s. to the dollar. In addition a strictly temporary exchange allowance is at present paid amounting to 20 per cent. of salary. Free passages and quarters. Candidates, aged 25-35, must have had experience as clerk of works or foreman of works on the construction of quay walls, jetties or wharves in stone and/or concrete and must be able to read plans and make measurement of completed work. —Apply at once by letter, stating age and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, quoting at head of letter M/12,606. 6792

Technical College, BRADFORD.

FULL-TIME DAY COURSES are provided in the various branches of Technology.

Special facilities are available for advanced study and research.

Further particulars and prospectuses may be obtained on application to the PRINCIPAL, Technical College, Bradford. 6742

Crystal Palace School of PRACTICAL ENGINEERING.
Principal : J. W. WILSON, M. Inst. C.E., M.I. Mech. E.
The NEW COURSE will commence on SEP. 10th. New Students enter at the School on the morning of Sep. 9th. 6729

PUBLIC NOTICES

The University of Sheffield.
SESSION 1924-25.
Vice-Chancellor : Sir HENRY HADOW, C.B.E., D. Mus., LL.D.

DEPARTMENTS OF MECHANICAL, ELECTRICAL, AND CIVIL ENGINEERING, METALLURGY, MINING, FUEL TECHNOLOGY, AND GLASS TECHNOLOGY.

The Courses in the above Departments extend over three or four years and prepare students to become specialists in one or other of these branches of Applied Science.
The LECTURE COURSES in all the Departments are supplemented by Practical Training in Laboratories and Workshops, which are fully equipped for the purpose of advanced scientific teaching, investigation and research.
Part-time Courses are arranged for students who desire to take special portions of any of the regular courses.
In Mining Engineering and in certain of the Courses in Mechanical and Electrical Engineering, and in Glass Technology, arrangements are made to enable students who come to the University from works or collieries to take six months' courses of study at the University and six months' practice at the works or colliery each year for a period of four years.
The LECTURE COURSES commence OCTOBER 1st, 1924.
The TECHNICAL LABORATORY COURSES commence SEPTEMBER 23rd, 1924.
For further details of the Courses and for particulars of the Degrees, Associateships, Diplomas, and Certificates awarded on their successful completion, application should be made to
W. M. GIBBONS, Registrar.
6712

The Polytechnic, 309, Regent-STREET, W. 1.
SCHOOL OF ENGINEERING.
President of the School : The Hon. Sir CHARLES PARSONS, K.C.B., M.A., LL.D., D.Sc., F.R.S., &c.
Head of the Department : ALEX. B. HORNE, O.B.E., B.Sc., (Hons. Eng.), F.E.S. (Edin.), &c.
THE DAY DEPARTMENT
RE-OPENS on SEPTEMBER 16th, 1924. Entrance Examination commences September 8th, 1924, at 9.30 o'clock.
Three-year DIPLOMA COURSES in
MECHANICAL ENGINEERING,
ELECTRICAL ENGINEERING,
MOTOR CAR ENGINEERING.
Practice in the Laboratories, Drawing-office, Workshop and Field.
Fee 21 Guineas per annum.
THE EVENING DEPARTMENT
RE-OPENS on SEPTEMBER 29th, 1924. Students enrolled from September 17th, 1924.
The Day and Evening Courses are recognised for the Diplomas and Certificates issued by the Institutions of Mechanical and Electrical Engineers in conjunction with the Board of Education.
Full prospectus free on application to the DIRECTOR OF EDUCATION. 6721

Woolwich Polytechnic.
LECTURER REQUIRED, ENGINEERING DEPARTMENT. Graduate with teaching, works, and drawing-office experience; to teach engineering science and drawing, and to lecture on workshop processes. Salary according to Burnham scale.—Particulars from PRINCIPAL. 6731

PUBLIC NOTICES

The Polytechnic, 309, Regent-STREET, W. 1.
A SPECIAL COURSE has been arranged for students taking the Studentship Examination of the Institution of Mechanical Engineers, the Preliminary Examination of the Institution of Civil Engineers, and the Final Examination of the Institution of Electrical Engineers (Part 1).
The classes are as follows :—

PURE MATHEMATICS	Monday, 7.30 to 9 p.m.
ENGLISH	Thursday, 6.30 to 8 p.m.
MECHANICS	Thursday, 6 to 9.30 p.m.
FRENCH	Monday, 6.30 to 7.30 p.m.
PHYSICS	Wednesday, 6.30 to 9 p.m.

The syllabus covers all the work in these subjects required for the examinations mentioned.
Fee for the Course £2 2s.
Prospectus free on application to the DIRECTOR OF EDUCATION. 6720

UNIVERSITY OF LONDON.
King's College.
FACULTY OF ENGINEERING.
COMPLETE COURSES of STUDY, extending over either three or four years, are arranged in
CIVIL, MECHANICAL AND ELECTRICAL ENGINEERING
for the Engineering Degrees of the University of London and for the Diploma and Certificate of the College.
The four years' Course provides, in addition to the academic training, opportunity for practical training in "Works."
HEADS OF DEPARTMENTS.
Professor G. COOK, D.Sc., M.I. Mech. E., A.M. Inst. C.E., Mechanical Engineering.
C. A. OEHNEVE, B.Sc., A.M.I. Mech. E., Senior Lecturer.
Professor A. H. JAMESON, M.Sc., M. Inst. C.E., Civil Engineering (Dean).
C. H. LOBBAN, B.Sc., A.M. Inst. C.E., Senior Lecturer.
Professor E. WILSON, M. Inst. C.E., M.I.E.E., Electrical Engineering.
F. S. ROBERTSON, M.I.E.E., Lecturer.
Professor S. A. F. WHITE, M.A., Mathematics.
Professor A. E. TOLLIFFE, M.A., ditto.
Considerable extensions have been made in the Engineering Department. These include a large additional drawing-office, lecture room, and laboratory for Hydraulics and Strength of Materials in the Civil and Mechanical Departments; and research rooms, including Wireless Telegraphy, in the Electrical Engineering Department. Large additions have been made to the equipment of the Laboratories in the three Departments for purposes of teaching and research.
There is a College Hostel and a large Athletic Ground.
For full information apply to the SECRETARY, King's College, Strand, W.C. 2. 6531

University of Manchester.
DEPARTMENT OF ELECTRICAL ENGINEERING.
DEPARTMENTS OF CIVIL, MECHANICAL AND ELECTRICAL ENGINEERING.
Full particulars of these Courses will be forwarded on application to the INTERNAL REGISTRAR. The Session COMMENCES on OCTOBER 2nd. 6674

PUBLIC NOTICES

University of Manchester.
PHYSICS DEPARTMENT.
Full particulars of the LECTURES and LABORATORY COURSES in PHYSICS, preparing for both the Ordinary and the Honours Degrees, will be forwarded on application to the INTERNAL REGISTRAR. 6737

Cardiff Education Committee.
THE TECHNICAL COLLEGE.
Principal : CHARLES COLES, B.Sc. (Lond.)
DEPARTMENT OF ENGINEERING.
Head of Department : A. W. LOVERIDGE, B.Sc. (Eng.), A.M.C.Sc.
SESSION 1924-25
(Commencing on TUESDAY, 7th OCTOBER, 1924).
The following Courses have been arranged for Engineering Students :—
A Three Years' Course in Mechanical and Marine Engineering, jointly with the University College of South Wales and Monmouthshire.
A Two Years' Course for Apprentices and others with facilities for practical experience in the Summer Term.
These Courses are suitable for students preparing for Degrees in Engineering or for the Examinations of the Engineering Societies.
Special Courses are also arranged for Marine Engineers preparing for the Examinations of the Board of Trade.
OPEN SCHOLARSHIPS, covering tuition fees and maintenance grants of £40 per annum for three years, are offered for competition annually and candidates for entry to the above Department are eligible to compete.
For further particulars of Full-time and Part-time Courses, Entrance Examination, Scholarships, Fees, &c., apply to the Principal. Application forms for Entrance Scholarship Examination, duly filled up, must be received before September 15th.
JOHN J. JACKSON, Director of Education, City Hall, Cardiff. 6770

Imperial College of Science AND TECHNOLOGY.
LONDON, S.W. 7.
APPLICATIONS are INVITED for the POST of DEMONSTRATOR in the MATHEMATICS and MECHANICS DEPARTMENT of the ROYAL COLLEGE of SCIENCE (some Engineering Experience essential). Salary, £300 per annum. Full particulars on application.—Candidates' applications, addressed to the SECRETARY, at the College, must be received not later than 5th September, 1924. 6607

Administrative County of LONDON.
TENDERS FOR NEW FIRE FLOAT.
The London County Council invites TENDERS for the CONSTRUCTION and SUPPLY of a TWIN-SCREW STEEL FIRE FLOAT with Internal Combustion Engines and Centrifugal Fire Pumps for the river service of the London Fire Brigade.
The specification, form of Tender, &c., may be obtained on application to the Chief Officer at the Headquarters Station of the London Fire Brigade, Southwark Bridge-road, S.E. 1, upon payment of the sum of £2, which will be returnable if a bona fide Tender is submitted and not subsequently withdrawn. Tenders must be addressed to "The Clerk of the Council" and endorsed "Tender for New Fire Float," and be delivered at the County Hall, Westminster Bridge, S.E. 1, not later than 4 p.m. on Monday, 6th October, 1924. No Tender will be received after that time. The Council does not bind itself to accept the lowest or any Tender.
JAMES BIRD,
6756 Clerk of the London County Council.

Westbury Urban District and WESTBURY AND WHORWELLSDOWN RURAL DISTRICT.
WATERWORKS WELL.
The Westbury and Dilton Marsh Joint Water Committee is prepared to receive TENDERS for the SINKING of a BRICK-LINED WELL about 110ft. deep, together with ADIT and all APPURTENANT WORKS, at Westbury, Wilts.
Quantities and site plan may be obtained at the office of the Engineers, Messrs. W. H. Radford and Son, Albion Chambers, King-street, Nottingham, on deposit of Two Guineas (cheque), which will be returned on receipt of a bona fide Tender and the return of the quantities.
Sealed Tenders to be delivered to the undersigned on or before Twelve Noon, Friday, September 12th. The Committee does not bind itself to accept the lowest or any Tender.
By Order,
J. H. H. HILLMAN,
Clerk to the Committee.
Westbury, Wilts,
August 26th, 1924. 6702

PUBLIC NOTICES (continued) Page 2.

SITUATIONS OPEN, Page 2.
SITUATIONS WANTED, Page 2.
PATENTS, Page 3.
PARTNERSHIPS, Page 3.
FOR SALE, Pages 3, 4 and 94.
AUCTIONS, Page 94.
BUSINESSES and PREMISES (For Sale, etc.), Page 4.
MACHINERY, &c., WANTED, Page 3.
WORK WANTED, Page 4.
AGENCIES, Page 3.

For Advertisement Rates see Page 239, Col. 1.

INDEX TO ADVERTISEMENTS, Page 93.

PUBLIC NOTICES

Corporation of Madras.

SPECIAL WORKS DEPARTMENT.
DRAINAGE SECTION.
CONTRACTS M and M. Nos. 464 and 474.
PUMPING PLANT.

The Corporation of Madras, India, is prepared to receive TENDERS from competent persons willing to enter into a contract for the SUPPLY and DELIVERY of SEWAGE PUMPING MACHINERY, consisting of Oil Engines and Centrifugal Pumps, Pipes and Accessories, &c., to be provided, erected and put to work and maintained at North Mylapore and Kings Garden Pumping Stations in the City of Madras, India.

Forms of Tender and contract in duplicate, with one set of drawings prepared by the Special Drainage Engineer to the Corporation, may be obtained from the undersigned, on payment of Ten Shillings for each contract, which will not be returned.

Tenders, accompanied by a deposit in currency notes or a draft on the Imperial Bank of India for Rs. 500, should be sent direct to the Commissioner, Corporation of Madras, so as to reach him not later than Twelve Noon on the 10th day of December, 1924.

The Corporation does not bind itself to accept the lowest or any Tender.

JAMES MANSERGH and SONS,
Agents to the Corporation of Madras.
5, Victoria-street,
London, S.W. 1.
21st August, 1924. 6717

County Borough of South-ampton.

RECONSTRUCTION OF COBDEN BRIDGE IN STEEL.

TENDERS are INVITED for the RECONSTRUCTION of the above-mentioned BRIDGE, having five spans of about 75ft. each, including the PROVISION of a TEMPORARY BRIDGE, APPROACHES and all incidental works.

Drawings of the proposed works can be seen at the office of the Engineer for the work, Mr. H. W. FitzSimons, B.Sc., M. Inst. C.E., 39, Victoria-street, Westminster. Copies of the specification, bill of quantities and form of Tender are to be obtained from the Engineer's office on payment of Five Guineas, which sum will be returned upon receipt of a bona fide Tender and the return of all documents.

Sealed Tenders, endorsed "Cobden Bridge, Steel," must be sent to the Town Clerk, Southampton, not later than Ten o'clock in the forenoon on Monday, the 15th day of September, 1924.

The Corporation do not undertake to accept either the lowest or any Tender.

R. R. LINTHORNE,
Town Clerk.
25th August, 1924. 6752

County Borough of South-ampton.

RECONSTRUCTION OF COBDEN BRIDGE IN REINFORCED CONCRETE.

TENDERS are INVITED for the RECONSTRUCTION of the above-mentioned BRIDGE, having five spans of about 75ft. each, including the PROVISION of a TEMPORARY BRIDGE, APPROACHES and all incidental works.

Drawings of the proposed works can be seen at the office of the Engineer for the work, Mr. H. W. FitzSimons, B.Sc., M. Inst. C.E., 39, Victoria-street, Westminster. Copies of the specification, bill of quantities and form of Tender are to be obtained from the Engineer's office on payment of Five Guineas, which sum will be returned upon receipt of a bona fide Tender and the return of all documents.

Sealed Tenders, endorsed "Cobden Bridge, Concrete," must be sent to the Town Clerk, Southampton, not later than Ten o'clock in the forenoon on Monday the 15th day of September, 1924.

The Corporation do not undertake to accept either the lowest or any Tender.

R. R. LINTHORNE,
Town Clerk.
25th August, 1924. 6753

East Indian Railway.

The Directors are prepared to receive up to 11 a.m. on Wednesday, the 17th September proximo, TENDERS for the SUPPLY of :—

(1) MOTOR VANS, GOODS BRAKE VANS, SHEEP VANS, and ACID TANK WAGONS.

Copies of the specification can be obtained at the Company's offices on payment of £1 1s. each. This fee will not be returned.

G. E. LILLIE,
Secretary.
73-76, King William-street, London, E.C. 4.
28th August, 1924. 6797

Port of Bristol.

GRAB HOPPER DREDGER.

The Docks Committee invite TENDERS for the CONSTRUCTION, DELIVERY and MAINTENANCE of a GRAB HOPPER DREDGER with a hopper capacity of 18,000 cu. ft.

N.B.—The Grab Cranes themselves are not included in the contract.

On and after Monday, the 8th day of September, 1924, copies of the specification, &c., can be obtained from the undersigned on production of a receipt to the undersigned showing that a deposit of £5 has been paid to the Bristol Docks Committee, to whom all cheques must be sent and made payable. The deposit will be returned to bona fide tenderers after the receipt of the Tenders with all the prescribed documents and drawings.

Tenders must be enclosed in a sealed envelope, endorsed "Tender for Grab Hopper Dredger," and addressed to the General Manager and Secretary of the Docks Committee, 19, Queen-square, Bristol, and must be delivered to him, accompanied by all the prescribed documents and drawings, before 10 a.m. on Monday, the 20th day of October, 1924.

The Docks Committee do not bind themselves to accept the lowest or any Tender.

THOMAS A. PEACE,
Chief Engineer.
Chief Engineer's Office,
Avonmouth Dock, Bristol.
27th August, 1924. 6781

For Sale by Tender.

BY ORDER OF MORTGAGEES AND RECEIVER FOR DEBENTURE HOLDERS.

Re Messrs. G. SCAMMELL and NEPHEW, Ltd., FASHION-STREET, SPITALFIELDS, LONDON, E. 1.

The Valuable and Extensive

FREEHOLD AND LEASHOLD

LAND AND BUILDINGS,

situate and known as above, the whole site area extending to about 4713 SQUARE YARDS, together with the various FACTORY and GARAGE BUILDINGS, providing a floor area of about 70,000ft. Super. Also the

PLANT, MACHINERY, STORES and STOCK-IN-TRADE.

TENDERS are INVITED for the PURCHASE of :

(a) The FREEHOLD and LEASHOLD LAND and BUILDINGS, with all PLANT, MACHINERY, STOCK and STORES, on the basis of a Going Concern, together with the GOODWILL of the BUSINESS.

(b) The FREEHOLD and LEASEHOLD LAND and BUILDINGS, having a frontage of about 332ft. to the South Side of Fashion-street.

(c) The FREEHOLD LAND and BUILDINGS, having a frontage of about 185ft. 9in. to the North Side of Fashion-street.

(d) The PLANT, MACHINERY, STOCK and STORES.

The Works, Plant, &c., may be inspected between the hours of 10 a.m. and 4 p.m. from September 1st to September 6th, 1924, inclusive.

Particulars, plan and conditions of sale, together with all information, may be obtained from—

Messrs. BECKINGSALES and NAYLORS, Solicitors, 24, Copthall-avenue, E.C. 2 ;

Messrs. FRANKLIN, WILD and CO., Chartered Accountants, Orient House, New Broad-street, E.C. 2 ; or

Messrs. HENRY BUTCHER and CO., Auctioneers, Valuers and Surveyors, 63 and 64, Chancery-lane, W.C. 2. 6695

PUBLIC NOTICES

Metropolitan Borough of ST. PANCRAS.

ELECTRICITY DEPARTMENT.

TENDERS are INVITED for the STRUCTURAL STEEL WORK required for BOILER-HOUSE EXTENSIONS. Specifications and drawings can be obtained at the offices, 57, Pratt-street, London, N.W. 1, on the payment of £2, which is returnable on receipt of a bona fide Tender.

Tenders to be sent in on or before Tuesday, 9th September, 1924.

The Council do not bind themselves to accept the lowest or any Tender.

C. H. F. BARRETT,
Town Clerk.
Town Hall, Pancras-road,
London, N.W. 1. 6780

State Electricity Commission OF VICTORIA.

MELBOURNE, VICTORIA, AUSTRALIA.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Yallourn Power Scheme.

Copies of Tender form and specification will be available upon application to—

Agent-General for Victoria,
Melbourne-place, Strand, London, W.C. 2.

SPECIFICATION NO. 24/88.—66,000-VOLT TRANSFORMERS, INDUCTION REGULATORS AND ACCESSORIES.

CHARGE.—£2 2s. for the first three copies of Tender form, conditions of contract and specification complete. This charge will be returned on receipt of a bona fide Tender. A fourth copy and any further copies will be supplied for the sum of 10s. 6d. each. This charge is not returnable.

PRELIMINARY DEPOSIT.—A preliminary deposit of £100 is to be lodged with Tender.

The specifications may be inspected at the above-mentioned office.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders, on the prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than 5 p.m., 1st December, 1924.

R. LIDDELOW,
Secretary.
6779

The Joint Committee OF THE

COUNTY COUNCIL OF THE COUNTY OF LANARK ; TOWN COUNCIL OF THE BURGH OF HAMILTON ; and TOWN COUNCIL OF THE BURGH OF MOTHERWELL AND WISHAW.

CLYDE BRIDGE, HAMILTON.

The Joint Committee are prepared to receive TENDERS for the CONSTRUCTION of a BRIDGE about 350ft. in length and 50ft. in width, of independent steel girder spans supported on piers or columns, with exposed facework of masonry, for carrying the public highway leading between Hamilton and Motherwell across the River Clyde, at a point about 120 yards below the present Clyde Bridge. Tenderers will require to submit their own designs.

The Tenders will not include the construction of the roadway forming the approaches to the bridge.

Drawings, showing the data to which Tenders and drawings submitted relative thereto are required to conform, may be inspected, and specifications and forms of Tender obtained on and after 1st September, 1924, on application being made to Messrs. Formans and McCall, C.E., 180, Hope-street, Glasgow. Early application is desirable and no specification will be given out after 30th September, 1924.

For each specification a deposit of £1 1s. will be required, which sum will be returned to the tenderer provided that he shall have sent in a bona fide Tender based on the drawings and specification, provided with a schedule of quantities fully priced out in detail, and shall not have withdrawn same. If contractors desire to obtain a set of drawings these will be supplied by Messrs. Formans and McCall at a charge of half-a-guinea per set.

The employment of labour shall be in accordance with the revised conditions of the Unemployment Grants Committee.

Tenders, on the forms prescribed, together with relative design and other documents as provided for in the specification, to be enclosed in a securely sealed envelope, endorsed "Tender for Clyde Bridge, Hamilton," and must be lodged with the subscribers not later than Ten o'clock a.m. on the 31st day of December, 1924.

The Joint Committee do not bind themselves to accept the lowest or any Tender.

J. McGHIE,
ROBERT BRYCE WALKER,
County Clerks.
County Offices, Hamilton,
25th August, 1924. 6776

Worthing Corporation Water-Works.

LONGFURLONG SUPPLY.

TO PIPE FOUNDERS AND PIPE LAYING CONTRACTORS.

CONTRACTS NOS. 3 AND 4.

The Corporation of Worthing invite TENDERS for LAYING about 2 5-8 MILES of 14in., 1 MILE of 9in. and ¾ MILE of 6in. CAST IRON SOCKET PIPES and for PROVIDING and LAYING about 500 YARDS of 9in. STONEWARE PIPES (Contract No. 3), and the SUPPLY of about 365 TONS of 14in. dia., 130 TONS of 9in. dia., and 55 TONS of 6in. dia. CAST IRON SOCKET PIPES (Contract No. 4).

Specifications, with form of Tender, general conditions and drawings, in respect of each contract may be inspected and obtained (on payment of Three Guineas, returnable if a bona fide Tender be made), on application at the Water Engineer's Office, Municipal Offices, Tudor Lodge, Chapel-road, Worthing, or at the office of T. and C. Hawksley, Civil Engineers, 24, Old Queen-street, Westminster, S.W. 1, on and after the 30th inst.

Tenders, endorsed "Waterworks," must be delivered at the Municipal Offices at or before Twelve o'clock Noon on Friday, the 19th day of September, 1924.

The Corporation do not pledge themselves to accept the lowest or other Tender.

J. KENNEDY ALLERTON,
Town Clerk.
Worthing,
August, 1924. 6758

County of Durham.

APPOINTMENT OF COUNTY SURVEYOR, ENGINEER AND ARCHITECT.

The County Council of Durham are prepared to receive APPLICATIONS for the POSITION of COUNTY SURVEYOR, ENGINEER and ARCHITECT.

The person appointed will be required to devote the whole of his time to the duties of the office, and will not be permitted to undertake any other business. The salary will be at the rate of £1400 per annum, rising by annual increments of £100, subject to satisfactory service, to £1700 per annum.

The appointment will be subject to three calendar months' notice on either side.

Applicants must have special qualifications as to the Construction of Roads and Bridges, and preference will be given to those who are under the age of 40 and who are Corporate Members of the Institution of Civil Engineers.

The appointment is a designated post under the Local Government and Other Officers' Superannuation Act, 1922, which has been adopted by the County Council, and the person appointed will be subject to the provisions of such Act.

All offices, staff, stationery, &c., will be provided by the County Council.

Applications, endorsed "County Surveyor," together with copies of not less than three recent testimonials, to be sent to the undersigned, not later than Wednesday, the 17th September, 1924, from whom a statement of the duties and conditions of the office may be obtained.

Canvassing will be deemed a disqualification.

By Order,
HAROLD JEVONS,
Clerk of the County Council.
Shire Hall, Durham,
15th August, 1924. 6692

PUBLIC NOTICES

REFUSE SALVAGE PLANT.

The Cleansing Committee of the Corporation of Leeds

are prepared to receive TENDERS for the SUPPLY and ERECTION, for the purpose of the reorganisation of a Destructor Depot, of the following PLANT :—

Crane and Grabs.
Screening Plant, Magnetic Separators, Belt Conveyors, and Clinker Runways.
Water-tube Boiler, Softening Plant, and Feed Pumps.
Electrical Generating Plant and Motors.
Clinker Crushing and Grading Plant.

Those desirous of tendering for any or all of the above should communicate with the undersigned not later than the 2nd September next.

J. B. HAMILTON,
Commercial Manager.
Sutton-st., Leeds. 6778

County Borough of Hudders-field.

BOROUGH ENGINEER'S DEPARTMENT.

APPOINTMENT OF DEPUTY BOROUGH ENGINEER AND SURVEYOR.

APPLICATIONS are INVITED from properly qualified persons for the OFFICE of DEPUTY BOROUGH ENGINEER and SURVEYOR.

Candidates must have had experience in the Surveying and Engineering Work of a Municipal Corporation, and have passed the Associate Membership Examination of the Institution of Civil Engineers or possess equivalent qualifications.

The inclusive salary is £450 per annum, and the appointment will be subject to one calendar month's notice on either side, expiring at the end of any month.

Applications on the prescribed form, to be obtained from the undersigned, are to be addressed to him at his office, 1, Peel-street, Huddersfield, endorsed "Deputy Borough Engineer," and delivered on or before Twelve o'clock Noon on Thursday, the 11th day of September, 1924.

Canvassing in any form is strictly prohibited, and will disqualify.

W. JAGGAR, Assoc. M. Inst. C.E.,
Chartered Civil Engineer,
Borough Engineer and Surveyor.
Borough Engineer's Office,
1, Peel-street, Huddersfield.
20th August, 1924. 6714

SITUATIONS OPEN

WANTED, a First-class COST ACCOUNTANT for works manufacturing Non-ferrous Plates, Sheets, Wire, &c. Only men with extensive experience need apply.—Applications to be sent to P9507, The Engineer Office. P9507 A

WANTED by CONTRACTING ENGINEERS in London for design of all classes of Handling Plants, ONE or TWO LEADING DRAUGHTSMEN with really first-class mechanical and structural experience. Permanency for suitable men. State age, experience, and salary required.—Address, 6747, The Engineer Office. 6747 A

WANTED for India, ENGINEER for Firm of Contractors specialising in Reinforced Concrete Construction. Applicants must have had good experience in this class of work and be practical designers. They should be competent to interview prospective clients and negotiate new contracts ; will be required to pass medical examination. Engagement for three years ; passage out and home on satisfactory completion of contract.—Address, 6796, The Engineer Office, giving two recent references and stating age, salary expected, and full particulars of experience. 6796 A

AGRICULTURAL ENGINEERS COST CLERK REQUIRED for Eastern Counties. State qualifications and salary required.—Address, 6716, The Engineer Office. 6716 A

ASSISTANT CIVIL ENGINEER, Single, Not Over 30, professional training and experience of Track and Construction abroad under contractors, knowledge of French.—Write, with fullest particulars, to Box 8491, c/o J. W. Vickers and Co., Ltd., 5, Nicholas-lane, E.C. 4. 6740 A

COMPANY Operating in East Africa REQUIRES an ENGINEER with good knowledge of Marine Type Oil Engines, 40-100 H.P., and with some experience on erection of machinery. Salary about £360 per annum with one servant allowance and free quarters. Passage out and home. Three years' agreement.—Address, sending copies only of testimonials, which will not be returned, P9492, The Engineer Office. P9492 A

ENGINEER REQUIRED, Must be Thoroughly experienced in designing Aerial Ropeways. Salary £750 per annum.—Address full details, experience, age, &c., 6767, The Engineer Office. 6767 A

EXPERT PRESS TOOL MAKER REQUIRED for North-East Coast, to make Large Compound Dies for Electrical Stampings.—Address, giving full particulars of experience and wages required, 6662, The Engineer Office. 6662 A

RESPONSIBLE POSITION Abroad Shortly VACANT for man with all-round knowledge of Machine Tools and first-class commercial experience. Knowledge of Railway Works practice essential.—Applicants should reply by letter, with full details of qualifications and remuneration required, to the CHAIRMAN, Associated British Machine Tool Makers, Ltd., 17, Grosvenor-gardens, London, S.W. 1. 6746 A

SALES ENGINEER, with Sound General Mechanical experience, able correspondent ; only live men with experience need apply.—Write, stating age, experience, and salary required, to Box 394, Dorland Agency, Ltd., 14, Regent-street, S.W. 1. P9502 A

SALES MANAGER (Cutlery, Tools and Steel).—APPLICATIONS are INVITED for the POSITION of SALES MANAGER to a large company with subsidiary companies in various parts of the country. Applicants should have had previous experience in organising the sale of cutlery, tools, tool steel, hollow-ware, plated goods, &c.—Address, 6725, The Engineer Office. 6725 A

THE MUNICIPALITY OF SINGAPORE, STRAITS SETTLEMENTS.

SUPERINTENDENT OF FITTINGS, GAS DEPARTMENT.

The Municipal Commissioners of Singapore REQUIRE a SUPERINTENDENT OF FITTINGS for the GAS DEPARTMENT. Age about 25, well educated, of sound constitution and unmarried. Candidates must have a good practical knowledge of Gas Fittings, Main and Service Laying, and General District Maintenance Work. The selected candidate must be of good education and address, as the Municipality lay on all services, together with internal fittings to private buildings, and the person appointed will come into contact daily with consumers, in case of complaints or new fittings, &c., whose requirements he will be expected to satisfy. Preference will be given to an experienced candidate who has been employed as a District Inspector, and the duties are those usually carried out by a Superintendent of Fittings. The selected candidate would work directly under the instructions of an Assistant Gas Engineer in charge of district work. The appointment will be on agreement for three years, with possible extension. The selected candidate must pass a medical examination as to his fitness for service in Singapore. A passage will be provided with half-salary during the voyage out. The salary will be 4560 dollars for the first, 5040 dollars for the second, and 5520 dollars for the third year, paid monthly, the value of the dollar being two shillings and fourpence sterling. For the first year the salary would be equal to £572 as above, with an allowance for such transport as may be required on duty.—Applications, stating age and place of birth, and giving details of education, training and experience generally, stating when free, accompanied by copies (only) of testimonials, and also personal references, to be lodged with Messrs. C. C. LINDSAY and PEIRCE, MM. Inst. C.E., 180, Hope-street, Glasgow, Agents to the Municipal Commissioners (from whom further information may be obtained), not later than Tuesday, 2nd September, 1924. 6681 A

SITUATIONS OPEN (continued)

SALESMAN.—One of the Oldest Firms in the London Lubricating Oil Trade, having provincial branches, REQUIRES a competent SALESMAN having a knowledge of the trade.—Write, Z. P., May's, 24, Burr-street, S.W. 1. 6759 A

TWO JUNIOR MECHANICAL ENGINEERS for Malaya.—SITUATIONS FILLED. Applicants thanked. P9501 A

WORKS MANAGER REQUIRED for Works Near London. Applications will only be considered from Britishers with considerable experience in similar positions, holding the highest credentials and having preferably practical experience with blast-furnaces, lime kilns, and grinding and conveying plant, with knowledge of works chemistry, and capable of taking entire control of personnel, output and maintenance. Permanent job with commencing salary of £500 p.a. Applicants should state concisely their previous experience, with dates.—Address, P9449, The Engineer Office. P9449 A

ASSISTANT DRAUGHTSMAN, One Used to Marine Engine Auxiliaries preferred. State age, experience, and salary required.—Address, 6745, The Engineer Office. 6745 A

CHIEF DRAUGHTSMAN WANTED for London Works AT ONCE ; one accustomed to Boiler Work, Jacketed Pans, Buoys, Stills, and all kinds of Pressure Work. State experience, salary required, and full particulars.—Address, 6751, The Engineer Office. 6751 A

DRAUGHTSMAN REQUIRED, Knowledge of Design and Construction of up-to-date Military Pontoon Bridges essential.—Write, stating age, full particulars, previous experience, and salary required, to Box 728, T. B. Browne's Advertising Offices, 163, Queen Victoria-street, E.C. 4. 6748 A

DRAUGHTSMAN WANTED in South of England for Refrigerating Work.—Address, with full particulars of age, experience, and salary required, 6732, The Engineer Office. 6732 A

EXPERIENCED LADY TRACER REQUIRED.—Write, stating age, experience, and salary required, to Box 730, T. B. Browne's Advertising Offices, 163, Queen Victoria-street, E.C. 4. 6705 A

FIRST-CLASS STRUCTURAL DRAUGHTSMEN REQUIRED, for North-East Coast. Must have had experience on Heavy Bridge Work, Foundations, Buildings, &c.; designing, preparing drawings for shops and estimating. State salary required. Others need not apply.—Address, 6305, The Engineer Office. 6305 A

HEAD DRAUGHTSMAN WANTED for Steam Pipe Factory in Midlands, capable of controlling drawing-office staff and organising systematic production of estimating and working drawings.—Address, P9499, The Engineer Office. P9499 A

JUNIOR DRAUGHTSMAN REQUIRED, Experienced in General Mechanical Work.—Address, stating age and experience, with copies of testimonials, 6772, The Engineer Office. 6772 A

JUNIOR DRAUGHTSMAN WANTED, Used to Centrifugal Pumps.—BLACKSTONE and CO., Stamford. P9517 A

REQUIRED for Argentine Railway, CHIEF DRAUGHTSMAN, Way and Works Department. Commencing salary £600 per annum. Age 32/35.—Applications, giving full particulars of training, experience, age, &c., to be sent with copies (only) of testimonials, to Box S. A., c/o Davies and Co., 95, Bishopsgate, E.C. 2. 6739 A

SENIOR DRAUGHTSMAN for Established Firm of Motor Manufacturers near London. Must be experienced in design of chassis components and all technical calculations connected therewith, accurate and reliable. Also JUNIORS for similar class of work.—Address, stating age, giving full particulars of experience, P9494, The Engineer Office. P9494 A

STRUCTURAL DRAUGHTSMAN WANTED IMMEDIATELY, used to Coal Screening and Sorting Plants, Pit Head Gears, &c. None but experienced men need apply.—Address, giving full particulars, 6744, The Engineer Office. 6744 A

FOREMAN, to Take Charge of Constructional Department in large Bridge and Constructional Engineering Works. Must have had considerable experience in this class of work. Man who has acted in similar capacity preferred.—Apply by letter only, giving particulars of experience, references, and salary required, to J. BUTLER and CO., Limited, Stanningley Ironworks, near Leeds. 6723 A

FOREMAN WANTED for Engine Assembly Shop, dealing with Aero-engine Erection and other Internal Combustion Engine Work. Previous experience in charge of similar department essential.—Address, stating salary required and details of experience, 6785, The Engineer Office. 6785 A

REQUIRED, FOUNDRY FOREMAN, Used to Railway Chairs, &c.; must be well up in repetition work and capols practice.—Address, stating age, experience, and salary required, P9515, The Engineer Office. P9515 A

TWO First-class STEEL WORK ERECTORS REQUIRED for Calcutta. Applicants should have had good experience in connection with the erection of large Steel-frame Buildings. The contract will be for twelve months in the first instance, with possibility of an extension for three years later.—Apply, stating salary required, age, and giving an outline of experience and copies of recent testimonials, to GENERAL MANAGER, Braithwaite and Co., Engineers, Ltd., Crown Bridge Works, West Bromwich. 6749 A

SITUATIONS WANTED

ADVERTISER DESIRES Responsible TECHNICAL-COMMERCIAL POST with manufacturing or consulting engineers. At present engineer and chief draughtsman engaged in high-speed and variable-speed steam engines, compressors, power plant, exhaust steam utilisation schemes, &c. Considerable commercial experience, estimating and travelling.—Write, Box 8838, c/o Brown's, 39, Tothill-street, Westminster. 6757 B

CAPABLE, Experienced MECHANICAL ENGINEER (37), wide business, commercial experience, works manager of machine, fitting, gear cutting works, sound motor engineering knowledge, drawings, estimates, correspondence, interviewing, DESIRES good POST requiring keen worker, energy, ability. First-class education.—Address references, V. N. M., "Craigie," Bretby-lane, Burton-on-Trent. P9510 B

ENGINEER DESIRES to INTEREST Well-established FIRM in an improved FORM of a MECHANISM, in considerable demand, involving small casting and accurate machine work.—Address, P9495, The Engineer Office. P9495 B

ENGINEER, ORGANISER MANAGER (36), Wh. Ex., A.M.I.M.E., SEEKS NEW APPOINTMENT. General Manager, Works Manager or Representative, where a sound knowledge of business organisation, energy, tact, ability and experience of 7 years' engs. management, D.O. training, estimating and costing is required.—Address, P9509, The Engineer Office. P9509 B

ENGINEER (29), with Sound Theoretical and Practical training with well-known firm, SEEKS SITUATION as ASSISTANT, home or abroad ; good experience in steam, gas, and oil engines, pumping and hydraulic machinery, machine tools. Excellent testimonials.—Address, P9498, The Engineer Office. P9498 B

For continuation of Small Advertisements see page 3.

A Seven-Day Journal

Bridge Demolition.

A novel method is being employed for the demolition of an old cast iron bridge, known as the Pont aux Anglais, in the Department of the Seine Inférieure. The bridge has seven spans with stone piers. The arches have been almost entirely removed by the expedient of building a massive timber platform underneath, supported by cables from scaffolding. The ends of the arch were cut through by oxy-acetylene blow pipes, when the mass of metal rested on the platform where it was cut in pieces convenient for removal. A cable runway was then installed over the bridge from standards 27 m. high on each bank. As the stone piers are demolished the material is carried away by travelling block pulley gears. The contractors will soon have to deal with the piers under water, and it is proposed to continue the operation by constructing metallic caissons around each pier. By removing the material in a way that will allow of the greater part being employed for construction purposes, it is hoped to recuperate about a third of the cost of the demolition.

French Naval Manœuvres.

The French members of the London Conference who were invited to the Naval Review at Spithead returned home with the conviction that more attention must be paid to the efficiency of the French navy. It has therefore been decided to organise a series of manœuvres and exercises during September. The Mediterranean squadron will assemble off the coast of Provence and will be visited by M. Herriot and other members of the Government, when the programme of the manœuvres, lasting about two weeks, will be prepared. Meanwhile, the northern squadron will have been engaged in various exercises, including torpedo practice, in Douarenez Bay and gunnery practice off Quiberon, and it will then take part in manœuvres having for their object the defence of the Atlantic coast, probably in conjunction with the Mediterranean Fleet, which will by then have terminated its operations off the coast of Provence. These demonstrations are intended, partly, to prepare the way for a more active prosecution of the French programme of naval construction.

Testing Westminster Bridge.

On Tuesday afternoon last, precisely at three o'clock, all traffic was held up at either end of Westminster Bridge for a period of five minutes. This interval was sufficient to allow the engineers of Messrs. Rendel, Palmer and Tritton to take readings of the loading conditions of the bridge when free from traffic, while the effect of the sudden renewal of normal traffic was also noted. The information gained during this test will serve to complete the work of testing the bridge, which has now been in progress for about five months. The report on the bridge, which is being prepared by Messrs. Rendel, Palmer and Tritton, for the London County Council, is now, we learn, well advanced and will be presented shortly. The Westminster Bridge was opened for traffic in 1862. It was built by Thomas Page, and work on it was begun in 1859. There are seven arches, each formed of seven ribs, which are of cast iron nearly up to the crown, where to avoid danger from the concussion of heavy loads they are made of wrought iron. The span of the arches varies from 90ft. to 120ft., and they have a height of from 16ft. to 20ft. above high water level. The design of the bridge was made to harmonise, as far as possible, with that of the adjoining Parliament buildings. Despite the greatly increased weight and speed of the traffic using the bridge, we believe the structure will be found to be very well preserved.

The Severn Barrage Scheme.

In a communication received from the Secretary of the Department of Scientific and Industrial Research we are informed that a committee has been appointed to proceed at once with certain preliminary investigations on the practicability of the carrying out of the Severn barrage scheme. The committee appointed to supervise and direct the work consists of Mr. G. S. Albright (chairman), Professor A. H. Gibson, M. Inst. C.E., Mr. G. W. Lamplugh, F.R.S., Mr. Maurice Wilson, A.M. Inst. C.E., and Dr. J. S. Flett, F.R.S., Director of the Geological Survey and Museum. With a view to ascertaining whether satisfactory foundations for the proposed barrage exist, the early work will comprise a study of the stratigraphical formations in the neighbourhood of the foundation sites proposed. Preliminary soundings with a view to determining the contour of the river bed at the sites will also be taken, and a measurement of the flow of water at different states of the tide will be made. The work of the Geological Survey has already been begun, and it is hoped that the staff report will be ready to place before the committee before the end of September. The data which will be provided as a result of the geological and hydrographical investigations made will be placed at the disposal of Sir Maurice Fitzmaurice, F.R.S., and Sir John Purser Griffith, M. Inst. C.E., who have been invited by the Government to submit a joint report on the possibility of constructing a barrage on one or more of the sites suggested, assuming that safe foundations exist. This report is expected to be completed before the end of this year.

The Mauretania's New Record.

Last week we chronicled the new record which had been made by the Mauretania on her recent voyage from Cherbourg to New York, when she steamed 3157 miles in five days three hours and twenty minutes at an average speed of 25.60 knots. An even better speed was maintained on her last eastward trip, for she arrived at Cherbourg at 6.42 on Tuesday evening, having made an average speed of 26.25 knots over a time of five days one hour and forty-nine minutes. On two successive days she made record runs of 625 and 626 miles, and from noon on Monday until Cherbourg was reached on Tuesday evening an average speed of 28.25 knots was maintained. This eastward bound trip is the fastest passage ever made by a liner.

Reorganising the Engineering Industry.

In the course of an address on the reorganisation of the engineering industry, given at the Summer School of the Independent Labour Party at Claughton on Friday last, Mr. W. L. Hichens said that as far as the engineering industry was concerned he believed that more could be done by reorganisation than by equipment. In order to extend our foreign trade he urged the necessity of establishing an Imperial and international organisation to think out a trade policy. Bigger units, he considered, were necessary in order to compete successfully with American competition. While there should be a policy of amalgamation, he suggested a moderate reduction of existing units rather than a large combine. At the same time monopolies, he thought, should be avoided, for competition was the greatest safeguard of the public. Our industrial welfare, he said, depended on the energy, initiative, courage, justice and public spirit of the individuals from the top to the bottom of the industrial body, and anything which tended to atrophy these qualities must be deplored. He regarded the present trade depression as lingering and malignant, and an early cure could not be expected. As a temporary measure he believed that it was inevitable that the real wages in this country should fall, for we could only hope to maintain and develop foreign trade if our prices compared favourably with those of our foreign rivals. Foreign competition was successful because of the lower wages paid and the longer hours worked. Concerted action was necessary if the worst results of international competition were to be avoided. He thought that the International Labour Office of the League of Nations should concentrate its attention on the difficult question of the relative values of wages in different countries. In the long run the standards of one country could not be improved at the expense of another and both must rise or fall together.

Takoradi Harbour.

It is announced that the Colonial Office has accepted the tender of Sir Robert McAlpine and Sons for the construction of the Takoradi Harbour on the West Coast of Africa. The scheme adopted is a modification of that which was originally put forward, and it has been prepared by Messrs. Rendel, Palmer and Tritton, Westminster, who are the consulting engineers to the undertaking. As projected, the harbour works include the construction of main and lee breakwaters with accommodation for three vessels on the lee breakwater. On this breakwater provision is also to be made for the storing and handling of a large quantity of manganese ore, while supplies of coal up to 5000 tons will also be carried. The shore buildings include warehouses for 50,000 tons of cocoa, and a quay for the reception of mahogany logs. The necessary railway sidings serving the harbour are also to be constructed. The actual value of the contract for the construction of the harbour has been stated as £1,700,000, and the whole cost of the completed undertaking is expected to be about £2,500,000. The work is to be begun immediately, and Messrs. McAlpine's engineers are, we learn, now on their way out to West Africa.

The City and South London Railway.

On December 1st the Moorgate to Clapham Common section of the City and South London Railway, which had to be closed in November last in consequence of the gas main explosion in Newington Causeway, is to be reopened. The opening of the Moorgate-Clapham section will mark the completion of the reconstruction of the entire City and South London Railway, which was the first electric tube railway in the world. All the stations have been rebuilt, and a new type of escalator, which enables passengers to step straight off instead of sideways, has been installed at the Oval and the Clapham Common stations. Work on the Morden line is in full swing day and night, and stations are being built at Nightingale-lane, Trinity-road, Tooting Broadway, Colliers Wood, South Wimbledon, and Morden. The task of enlarging the tunnels on the City and South London Railway began in 1922. They have been enlarged to 11ft. 8½in., which is the standard dimension for the underground tubes.

Cheaper Electricity.

Speaking at a luncheon held in connection with the opening of the new Edinburgh to Glasgow arterial road, the Minister of Transport, Mr. Harry Gosling, referred to the prospects of cheaper electricity. Legislation is to be put forward this autumn for placing the generation of electricity more in the public hands. It was hoped, Mr. Gosling said, that by standardising the frequency and by more co-operation in generation to cheapen electricity to such an extent that it would even be used in rural areas and that it would be employed much more extensively for domestic purposes. He believed that electricity should be made available in every working-class home. The Government was doing all that it could to bring out a cheap electricity supply and to some extent public funds were being applied to that end.

The Witbank Power Station.

In consequence of an agreement with the Electric Supply Commission, an electric power station is to be built at Witbank in the Eastern Transvaal. The station is to be constructed by the Victoria Falls and Transvaal Power Company, and will supply electricity to the mines lying between the Rose and Glen Deep on the east, and to the Crown Mines on the west. With the exception of the mines supplied by the East Rand, Randfontein and the Kleinfontein power station, the mining groups on the Rand will take their supply of electrical energy from the power company during the life of the various mines or for a period of twenty years, according to circumstances. The new station is designed to accommodate five 20,000-kilowatt turbo-generating sets. It is believed that the total cost of generation at the station will be the lowest of any station in the world, as the plant is to be constructed to burn cheap slack. Large quantities of this class of fuel are available at Witbank.

Glasgow's New Bridges.

It seems likely that yet another bridge will have to be constructed in order to relieve the traffic congestion across the Clyde in the centre of Glasgow. It is reported that a special sub-committee appointed by the Glasgow Corporation has recommended the construction of another bridge upstream from the present Jamaica Bridge. The proposal will, we learn, involve expensive acquisitions of business property for street widening purposes in Dixon-street, besides the removal of the St. Enoch Parish Church and the Subway Railway Station in the centre of St. Enoch-square. It will be remembered that a new bridge is at present being constructed at Oswald-street, a few hundred yards to the downstream side of the Jamaica Bridge. This is a reinforced concrete bridge with three arches, and was designed by the Considere Construction Company, Limited. It is estimated that it will cost £100,000.

Naval Contract from Australia.

The Australian Naval Defence Bill has now passed through both houses of the Federal Parliament, and will presumably be put into force without delay. It provides, *inter alia*, for two new cruisers, each displacing 10,000 tons. One ship is to be ordered in Great Britain, while the other will be laid down at Cockatoo Island Dockyard, Sydney, according to present plans, though it may eventually be decided to have the second cruiser built in this country also. Estimates prepared by the Government, as we mentioned a few weeks ago, show that a substantial saving in money and time would be effected if both vessels were ordered from British builders, though political and economic reasons may impel the authorities to have one ship constructed in Australia. There is, of course, no question as to the ability of the Sydney dockyard to undertake this work. Some years ago that establishment built the light cruiser Brisbane, of 5400 tons, and at a later date it constructed both the hull and machinery of the slightly larger Adelaide, which ship is now accompanying the Special Service Squadron on its homeward voyage. There will, no doubt, be keen competition among British firms for the new Australian cruiser as soon as tenders are invited. Including armament and equipment, the contract should be worth something like £2,000,000, a large proportion of which will go in wages. Since standardisation of material is now an accepted principle of Empire Naval policy, the Australian cruisers will probably resemble in all essential features the five "County" ships which are to be laid down this year for the Royal Navy, just as the Melbourne, Sydney, Brisbane, and Adelaide were all modelled closely on the British "Chatham" class. Several large submarines are also projected for the Australian Fleet, but no decision seems to have been reached as to where these boats shall be constructed.

The British Empire Exhibition.

ENGINEERING EXHIBITS, No. XIX.*

GENERAL ENGINEERING EXHIBITS.

HICK, HARGREAVES AND CO., LIMITED.

The Uniflow steam engine exhibited by Hick, Hargreaves and Co., Limited, Bolton, is designed for developing a normal full load of 325 indicated horse-power when running at a speed of 180 revolutions per minute, and working with superheated steam at 180 lb. pressure per square inch. The cylinder is built up of three separate castings, comprising barrel

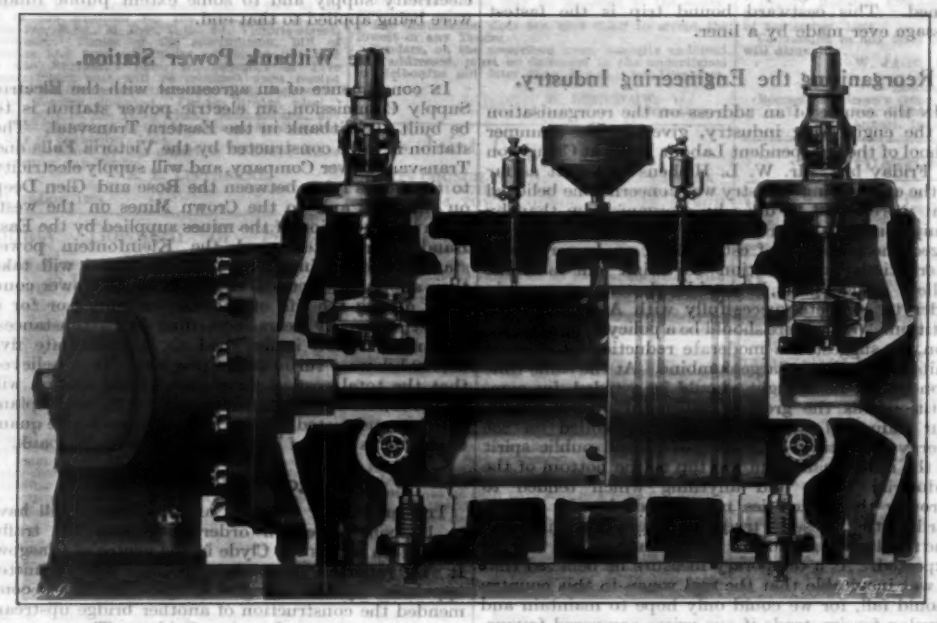


FIG. 372—SECTION THROUGH CYLINDER OF UNIFLOW ENGINE—HICK, HARGREAVES

and ends, which enables the barrel to be made of the hardest possible mixture of cast iron. The central exhaust ports are machined out of the solid after the cylinder is bored by special machinery, the inner edges being carefully rounded off. In the earlier days of the Uniflow engine considerable trouble was, as is well known, experienced with cracked cylinder barrels, caused by the ends of the barrel expanding to a greater extent than the centre portion in accordance with the temperature gradient in the cylinder metal from the centre to the ends. This trouble has now been overcome by boring the barrel in such a way that when the engine is working under

FIG. 373—VALVE GEAR OF UNIFLOW ENGINE

normal conditions the bore is parallel. The cylinder is lagged with planished sheet steel, provided with substantial angle iron beading of special design, to ensure a rigid construction combined with a neat appearance. To enable access to the back cylinder joint to be obtained easily, a movable strip of lagging is provided. A section through the cylinder is shown in Fig. 372. The distribution of steam is performed by piston valves controlled by trip gear of simple and robust design, which work in conjunction with a high-speed governor. This arrangement gives a sensitive control of the distribution, and the advantages claimed for it are quick port opening and extreme steadiness of running under all conditions of load. To minimise wear of the trip edges they are made extra large. The gear generally is constructed in accordance with the latest ideas in the design of drop valve engines, and has proved perfectly satisfactory. The valves are fitted with rings carefully machined and ground to fit the liners, and are of the simplest possible construction, the bodies being made in three separate parts securely held together by the valve spindle, which passes right through the centre. The valves are firmly locked in position on the spindles by means of double helicoid nuts. All the valve liners are made of special close-grained cast iron, and are shrunk into the cylinder ends. After this operation is completed a finishing cut is taken through the valve liners to ensure that they are perfectly circular before the valves are put in. The use of the piston valve permits the employment of an air dash pot to bring the valve to rest on its downward travel. There are thus no shocks due to the valves striking their seats, and smooth working is assured, no matter what the variation of the load on the engine may be.

With a view to reducing radiation losses and initial condensation of steam in the cylinder to a minimum, all the internal surfaces of the cylinder, and also the outsides of the valve bodies in contact with the working steam in the cylinder, are carefully polished. The valve gear is shown in Fig. 373.

The governor, illustrated in Fig. 374, is of the high-speed enclosed type, designed to maintain the engine speed within very fine limits. A special feature of the governor arrangement is the safety trip gear, which is a familiar design, and has been used for many years on mill engines in Lancashire and elsewhere. Its function is to shut off steam to the cylinder when the engine approaches either too high or too low a speed. In the latter case, this gear is particularly advantageous, as should the engine tend to pull up owing to a heated bearing, it is quickly brought to rest before any extensive damage is done to the bearing concerned. The safety trip gear pulls up the engine by moving the governor rods into such a position that the trip "bits" do not engage, and consequently the valves are not opened by the valve gear, thus bringing the engine to rest.

In Uniflow engines it is necessary to have automatic clearance valves, the object being to prevent undue compression pressure being developed in the cylinder should the vacuum fail at any time. One of the clearance valves fitted to this engine is shown in section in Fig. 375, its position being that in which the valve covers the ports in the liner. The annulus round these ports is in communication with the working steam in the cylinder. Should the compression pressure rise unduly the relief valve A will open, allowing steam to pass between the differential diameters B and C of the valve spindle, causing the valve to move to the right, uncovering the ports and opening the clearance space D to the cylinder. The additional clearance space thus obtained prevents the compression pressure rising above normal. The valve is closed by moving the spindle inwards. It will be noted that a knob is provided at the right-hand end of the spindle, which permits the attendant to try the valve at any time. In addition to the automatic clearance valve, an ordinary spring-loaded relief valve is provided at each end of the cylinder, to act as a further safeguard against damage due to excessive compression or presence of water in the cylinder.

The frame of the engine, which is of massive construction, is arranged with oil-tight inspection doors and crank splashers, so that the engine-room floor can be kept in a clean condition. The crank pit is of extra large size, and is cast in one piece with the main frame. A difficulty in connection with frames of the enclosed type is the return of the oil from the crank pit to the oil pump tank. This is overcome by providing drain pipes of extra large diameter, and also a sump in the crank pit, where the oil can collect before entering the drain pipe. The frame is also provided with an oil-return duct from the cylinder end of the frame to the crank pit. This is an important item, as it prevents a large quantity of oil collecting at the cylinder end of the frame, where it may become heated and give off vapour in the engine-room, which is objectionable. The duct provided leads the oil instantly back to the crank pit, and prevents this taking place. In addition, a circular splash plate is fitted in the engine frame at the cylinder end, and provided with a wiper ring to remove any surplus oil from the piston-rod, thereby preventing the oil from being drawn into the cylinder. The connection between the cylinder end and the main frame is designed to give as small a metallic contact between

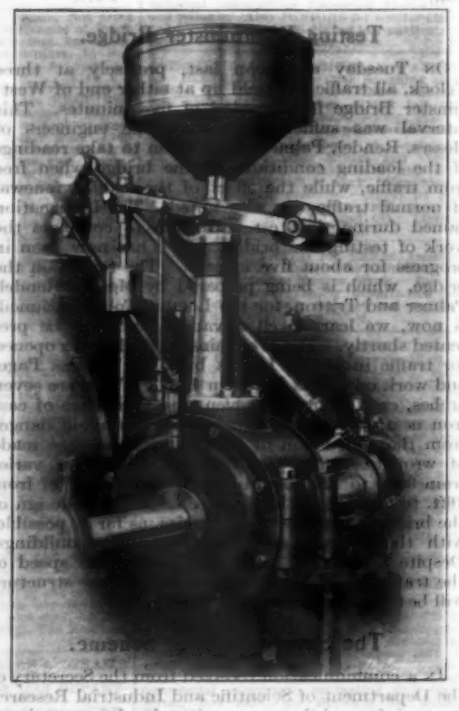


FIG. 374—GOVERNOR OF UNIFLOW ENGINE

these two parts as possible, so that the conduction of heat through the cylinder to the frame is reduced to a minimum.

For lubrication purposes, an oil pump of the cog-wheel type is driven by machine-cut gearing direct from the valve gear lay shaft. This arrangement minimises a possible breakdown of the oil pumping arrangement, the pump itself being of the simplest possible design, compatible with high efficiency. The capacity of the pump is fully equal to the duty required. The lubrication of all the main motion parts is on the forced feed system, the oil pump tank being fitted with a cooling coil to keep the temperature of the oil low. The pressure of the oil is usually about 5 lb. to 10 lb. per square inch, and is regulated by a spring-loaded relief valve. An alarm bell is fitted to call the attention of the attendant should the oil pressure fall unduly. In addition to the pump driven from

* No. XVIII. appeared August 22nd, 1924.

the engine a hand-operated pump is provided, and by it a flush of oil may be given to the bearings, &c., before the engine is started up.

The cylinder and steam inlet valves are lubricated by means of a mechanical sight-feed lubricator, positively driven from a pin in the end of the lay shaft, and, in addition, the cylinder barrel is provided with a combined flush and displacement lubricator, by which means the cylinder may be flushed independently at will. The valve gear is shown in operation at the Exhibition, the lay shaft being driven by an electric motor through reduction gearing. The pump supplying oil under pressure to the main motion parts is also driven from this lay shaft through machine-cut spiral gearing, and the alarm bell previously referred to can also be shown in operation if desired.

The engine is arranged to drive a horizontal double-acting air pump from the engine crank shaft by a crank and pin, the connection to the pump being by a coupling-rod and bell crank lever. The air pump, which is arranged to be placed below the engine-house floor, is not exhibited on the stand. These engines are built in sizes ranging from 150 to 1200 indicated horse-power, and they are designed to be capable of developing 25 per cent. overload continuously with very slight increase in the consumption of steam per indicated horse-power per hour. The makers claim that a 10 per cent. overload will have no appreciable effect on the steam consumption.

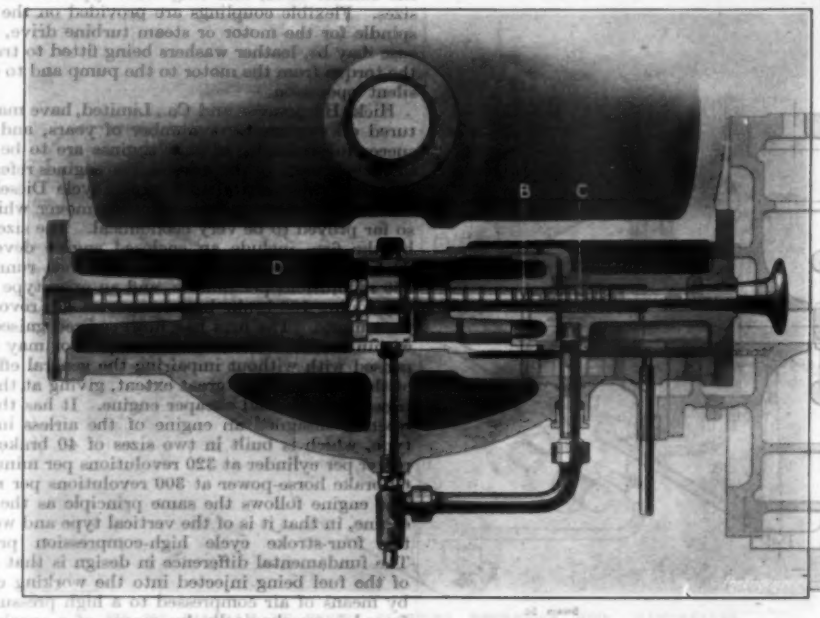


FIG. 375—SECTION THROUGH CLEARANCE VALVE OF UNIFLOW ENGINE—HICK, HARGREAVES

Fig. 376 represents a double-cylinder barring engine made by Hick, Hargreaves and Co., Limited. These engines are supplied with all steam engines of over 500 indicated horse-power, and they have proved of great value for the following purposes:—(*a*) Moving the engine round slowly before starting and allowing all parts to be uniformly warmed, thus avoiding straining from unequal expansion; (*b*) moving the engine for setting valves, examining pistons or air pumps, and other similar purposes; (*c*) putting on or repairing driving belts or ropes. The engine is designed to give an upward thrust of 6000 lb. on the rack of a fly-wheel rim, and it will work satisfactorily, we learn, with steam at 180 lb. per square inch, and superheated 150 deg. Fah. It is shown in operation on the stand and is driven by an electric motor through reduction gearing. The principle of action is as follows:—When steam is turned on the barring engine the worm and worm wheel at first revolve without the latter engaging with the teeth in the fly wheel. On pressing the lever shown in the illustration the side of the worm wheel away from the worm is held by friction and the worm pushes the worm wheel into contact with the teeth of the fly-wheel when it commences to drive the latter, the driving force, coupled with the thrust of the worm, keeping it in gear so long as the barring engine is the driver. The moment the main engine becomes the driver the worm wheel turns on the worm as a fulcrum, and moves out of gear, two light springs retaining it in that position. It will be noted that quite apart from the action of these springs it is impossible for the worm to engage with the teeth of the moving fly-wheel, as the moment the worm wheel comes in contact with the fly-wheel it will be pushed back again. The barring engine on the stand is fitted to give a downward thrust, but by slight modification it can be arranged for an upward thrust.

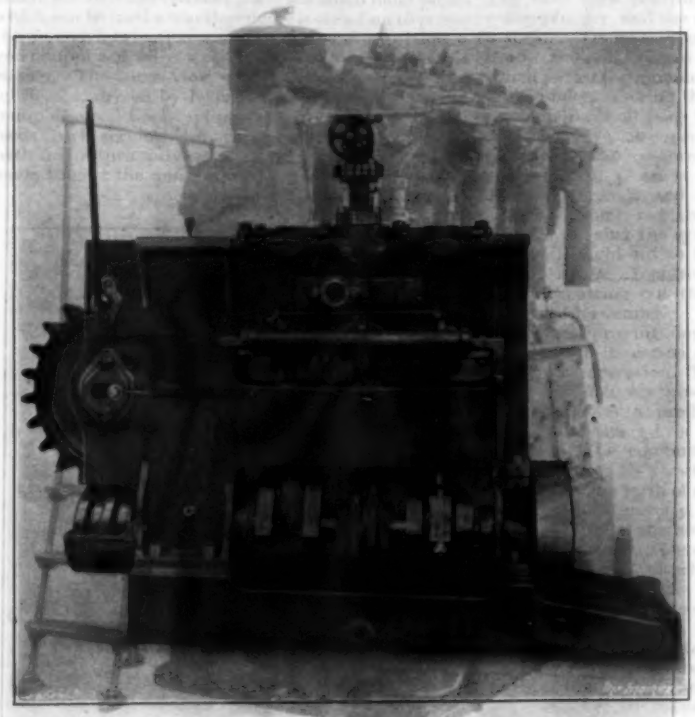


FIG. 376—DOUBLE-CYLINDER BARRING ENGINE—HICK, HARGREAVES

Another interesting exhibit on Hick, Hargreaves and Co.'s stand is a working model of Bailey and Jackson's patented rotary water strainer for dealing with the circulating water of surface-condensing plants. The advantages claimed for this water strainer are:—(1) It is entirely self-contained and automatic; (2) no extensive foreshore construction is required; (3) it operates equally well under pressure or vacuum; (4) it reduces the cleaning of condenser tubes to a minimum; (5) no scrapers are used; (6) the flushing water for cleaning the grids is a portion of that which has already passed through the strainer. A sectional view of the strainer is given in Fig. 377. The strainer consists of a wheel which rotates slowly inside a circular casing. This wheel is provided between its spokes with grids made of brass strip bent in such a form as to provide a straining medium with a fine mesh and exceedingly strong. This construction of strip prevents interlacing or weaving of fibrous *débris* which is dislodged from the screen by the circulating water by-passed for the purpose. In the illustration, Fig. 377, A is the worm wheel drive, B the rack for rotating the grids, C the shaft which carries the grids, D the adjustable diaphragm for cleaning the water, P the diaphragm packing plates, S the bearing wedges, T the thrust collar, and W the rotating straining grids.

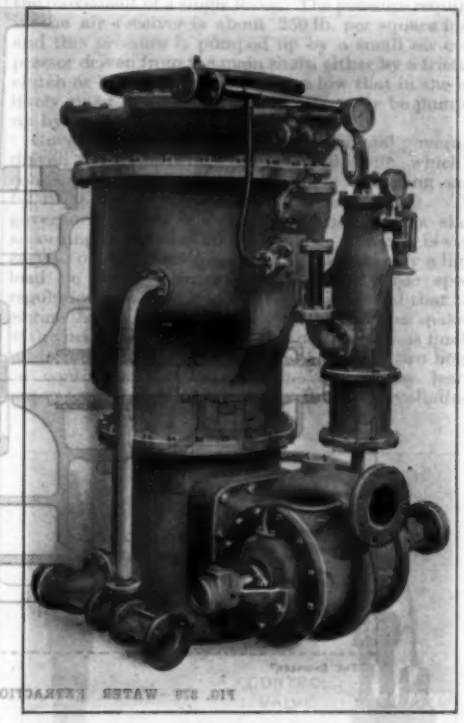


FIG. 378—MULTI-JET CONDENSER—HICK, HARGREAVES

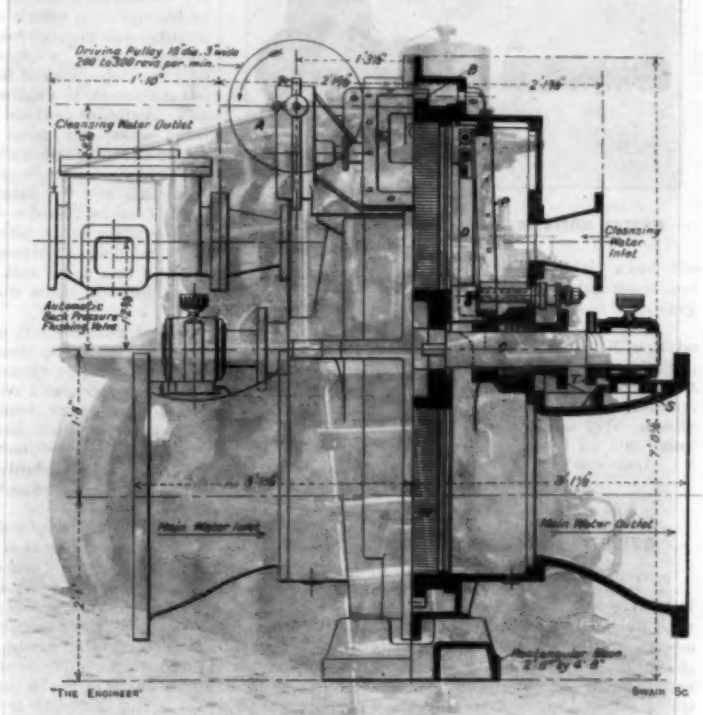


FIG. 377—ROTARY WATER STRAINER—HICK, HARGREAVES

The deposit is discharged into a collecting chamber formed on the strainer body, from whence it is returned to the river or other source of supply at a point where it cannot re-enter the circulating system.

The use of a portion of the circulating water for cleansing the screen makes any scraping action over the face of the latter unnecessary and ensures cleanliness being maintained indefinitely. The circular screen is slowly rotated by means of a small motor varying from 1 horse-power to 4 horse-power, depending upon the size of the strainer used. The motor drives in the usual way through a worm reduction gear and pinion, the latter gearing with a rack on the periphery of the strainer. The action of the strainer is entirely automatic, and effective screening commences immediately the circulating pump is started, and it is claimed that under no condition whatever can foreign matter to any extent enter the condenser. The effect of a deposit on the inside of the tubes of a condenser is twofold, inasmuch as, in the first place, it prevents the transmission of heat from the steam to the circulating water, and it also impedes the flow of the circulating water through the tubes. The result of this twofold effect is that the vacuum is adversely affected. The steam consumption of a steam turbine is usually understood to vary about 6 per cent. for each inch of vacuum below that for which the machine was designed. The importance, therefore, of maintaining the vacuum at the rated figure or above, wherever possible, is at once apparent. A simple calculation of the loss due to increased steam consumption with a given load will, the makers point out, readily show the great advantages of a strainer of the kind just described.

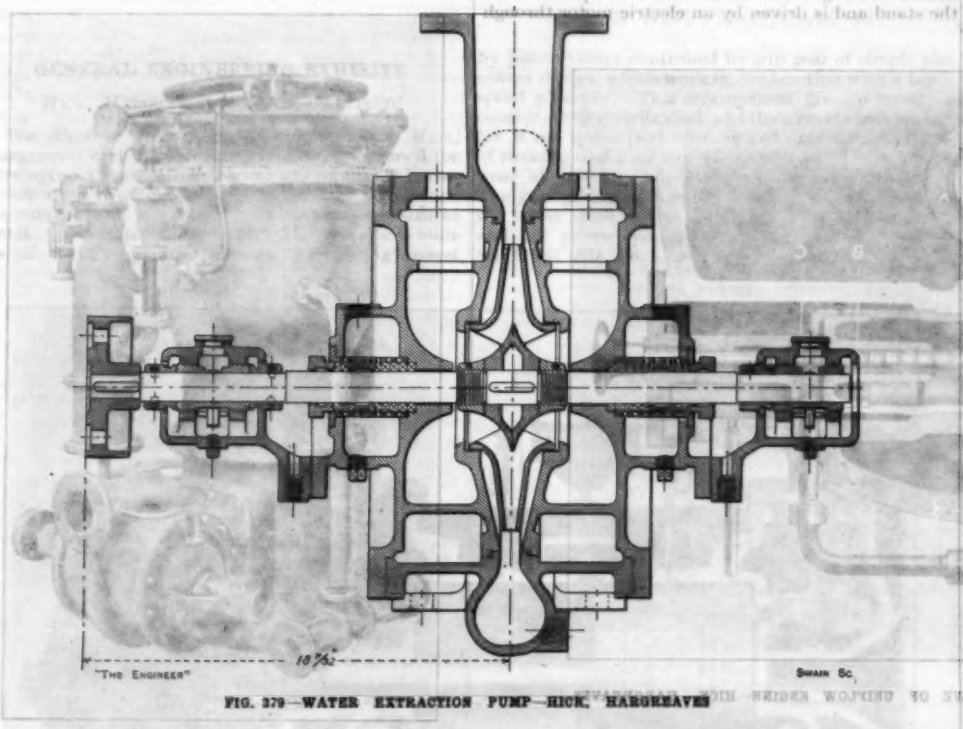


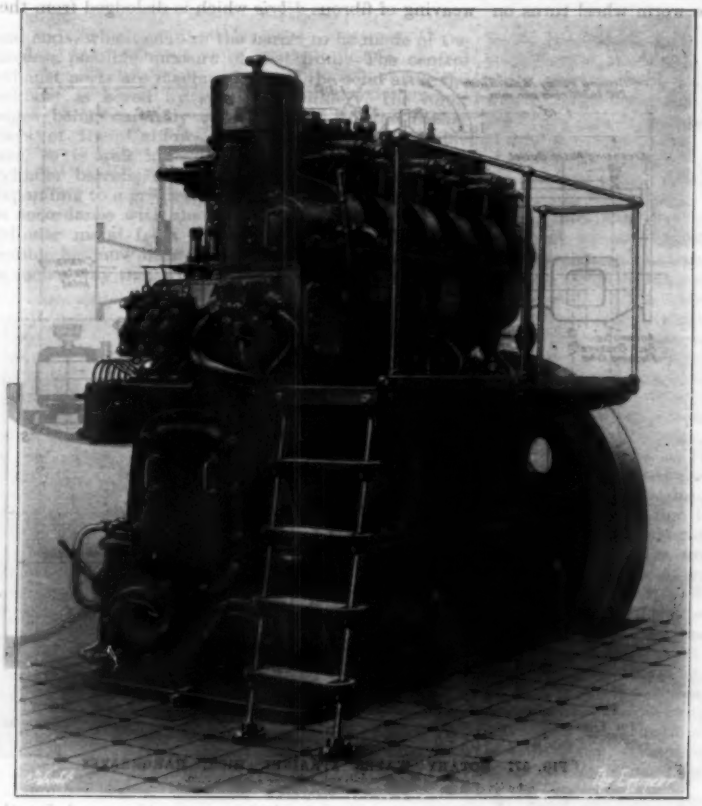
FIG. 379—WATER EXTRACTION PUMP—HICK, HARGREAVES

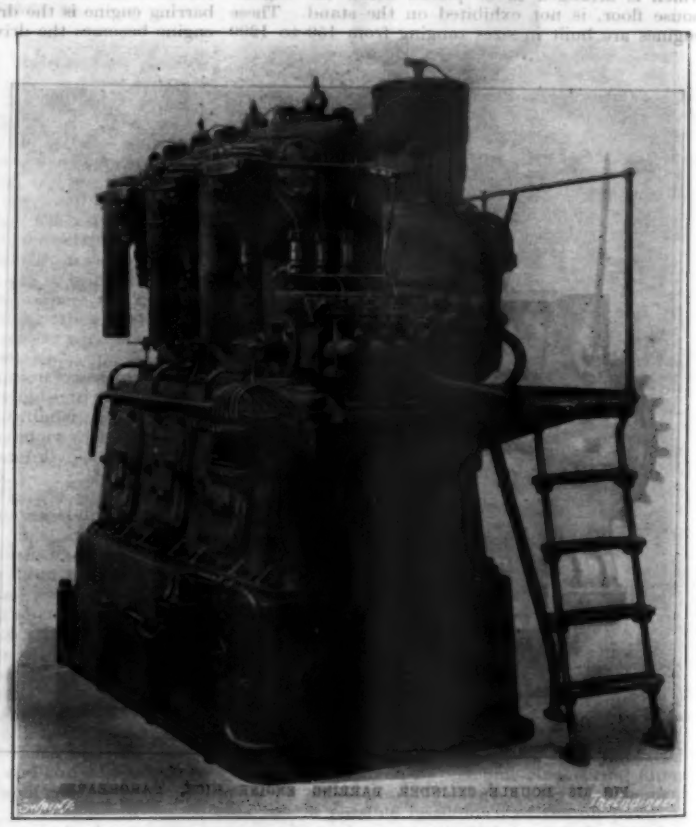
A multi-jet condensing plant by the same makers is shown in Fig. 378. It is fitted with the Hick-Breguet air extracting apparatus, or "Ejectair," and is typical of many plants supplied by the firm for all classes of industry where high vacuum is required. In the illustration the water extracting ejector is shown fitted at the side of the plant. The "Ejectair" was described in THE ENGINEER of April 28th, 1922. We are informed that, in addition to the many jet plants fitted with the Hick-Breguet "Ejectair" which have been supplied, surface condensing plants fitted with the "Ejectair" having a total capacity of 370,000 kilowatts have been made since the year 1915.

The water extraction pump—Fig. 379—is of the single-stage centrifugal type and is operated by an electric motor or by mechanical means, as may be found convenient. The impellers are made of a zinc-free alloy, while the spindles are made of nickel steel. If required, the spindles can be made of that material, and, in addition, provided with gun-metal sleeves, in this way protecting the spindle from the action of the water. In the larger sizes of pumps the spindle packings are of the labyrinth type, so as to reduce packing renewals to a minimum, in addition to which the usual water sealing arrangements are provided. The bearings are of the ball or roller type in the smaller sizes, and ring oiled type in the larger sizes. Flexible couplings are provided on the pump spindle for the motor or steam turbine drive, as the case may be, leather washers being fitted to transmit the torque from the motor to the pump and to ensure silent operation.

Hick, Hargreaves and Co., Limited, have manufactured oil engines for a number of years, and many successful examples of such engines are to be found in various parts of the world. The engines referred to are all of the vertical four-stroke cycle Diesel type, with air injection, a type of prime mover which has so far proved to be very economical. The sizes built by the firm include an enclosed engine developing 80 brake horse-power per cylinder when running at 250 revolutions per minute, and an open type engine developing 100 brake horse-power at 175 revolutions per minute. The firm has, however, recognised that, within certain limits, the air compressor may be dispensed with without impairing the general efficiency of the engine to any great extent, giving at the same time a smaller and cheaper engine. It has therefore recently designed an engine of the airless injection type, which is built in two sizes of 40 brake horse-power per cylinder at 320 revolutions per minute and 60 brake horse-power at 300 revolutions per minute. The engine follows the same principle as the earlier engine, in that it is of the vertical type and works on the four-stroke cycle high-compression principle. The fundamental difference in design is that instead of the fuel being injected into the working cylinder by means of air compressed to a high pressure, it is forced in mechanically by means of a specially designed pump; hence the fuel pump, the regulation of the fuel and the design of the fuel injector, with its method of operation, need to be of a different pattern.

The engine shown on the stand at Wembley has three cylinders and is rated to develop 120 brake horse-power when running at 320 revolutions per minute. Figs. 380 and 381 give views of the complete engine, which, it will be noticed, is of the totally enclosed type. The engine follows standard practice as far as the design of the bed-plate, crank shaft, connecting-rod, cylinder, and piston is concerned. Lubrication has been specially provided for, and all the oil drains to one end of the bed-plate, which forms a sump in which is placed a valveless pump working under a constantly flooded suction. This pump is driven from the foot of the vertical shaft, and easy access to it may be obtained through the right-hand





FIGS. 380 AND 381 THREE-CYLINDER 120 B.H.P. AIRLESS-INJECTION OIL ENGINE—HICK, HARGREAVES

door shown at the end of the bed plate, by the removal of which the whole pump unit can be readily withdrawn. The pump delivers the oil through an efficient filter and an adjustable spring-loaded relief valve to the main distributor, which is furnished with leads to all the main bearings. The crank shaft and connecting-rod are bored so that oil is supplied through them to the bottom and top end bearings of the connecting-rod. A supply pipe is also taken to the vertical shaft footstep bearing and another to the cam shaft, which is hollow, and is made to carry forced lubrication to each cam shaft bearing. From the cam shaft supply a further pipe is carried to a sight-feed lubricator placed at the uppermost point on the engine, as may be seen in the illustrations. This useful fitting enables the engine-driver to see at a glance whether the forced lubrication system is working efficiently.

The cam shaft with all its bearings and cam rollers works in an enclosed case, with a weir at one end to maintain a constant level of oil, into which the cam peaks dip continually. The quiet running of the cam shaft and its gear is a noticeable feature in the running of the engine. Each pair of gear wheels on the engine is either supplied with a jet of oil or is arranged so that the teeth run in an oil bath. Some of the forced lubrication fittings are plainly visible in Fig. 381, and it will be observed that there is a small hand pump which can be used when the engine is standing to prime the forced lubrication system, thus ensuring that a good supply of oil is available when starting up the engine. The same view shows the six-feed cylinder lubricator, driven by levers from the end of the fuel pump shaft. Each cylinder is provided with two feeds, each serving two nozzles, and each furnished with non-return valves. Every endeavour has been made to give the question of lubrication very special attention, so that the engine may operate for long continuous periods with a minimun amount of attention.

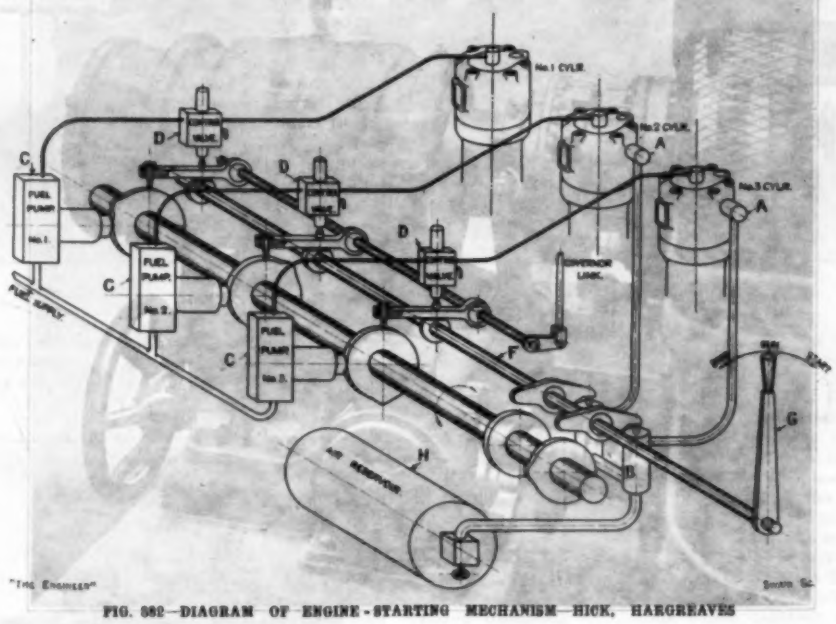


FIG. 382—DIAGRAM OF ENGINE-STARTING MECHANISM—HICK, HARGREAVES

FIG. 383—CYLINDER COVER—HICK, HARGREAVES

Fig. 383 shows a view of the cylinder cover with the exhaust valve on the right-hand side and the air inlet valve on the left-hand side, which are placed horizontally. The fuel injection valve, which will be referred to later, is shown on the top of the cylinder.

The valve-operating gear is very neatly arranged. The inner valve is operated directly by the lever, which is pivoted in a bearing fixed in the top of the cam shaft casing cover. The back valve is operated by a similar lever, which actuates a horizontal push rod, clearly shown in Fig. 381. This back valve is opened by a horizontal lever, and consequently the push rod ends must be designed to accommodate these two levers operating in different planes. There is now, we learn, a large number of engines in operation fitted with horizontal valves which are giving satisfaction, which should remove any slight prejudice which may exist regarding such an arrangement.

Inspection doors are fitted to all cooling water spaces, so as to permit of these parts being kept clean and free from deposit. The water, after passing through the cylinder, enters the cylinder heads, and there is provided a visible outlet, which is fixed near the platform base.

The fuel injection system used on the engine is of special interest. Fig. 384 shows a complete unit detached from the engine. It consists of a pump, a control valve, in which a filter is incorporated, and a fuel injection nozzle. The pump details, including the plunger and guide, are shown dismantled. It will be noticed that the plunger is of the glandless type, and it is made of special steel, which is case-hardened and ground. The pump suction and delivery valves are of the ordinary pattern. There is one fuel pump to each cylinder, and all the pumps are arranged in a group at the end of the engine—as shown in Fig. 381—and are operated by cams carried on a cross shaft and driven by gearing from the vertical shaft. The cam only controls the delivery stroke of the pump plunger, and the suction stroke is performed by a spring. On its way to the fuel valve in the cylinder head, the oil passes through a control valve, which varies the amount of oil actually delivered to the cylinder. During the remainder of its stroke, the pump delivers oil back to the suction chamber. The control valve is operated from the same cam mechanism which determines the delivery stroke of the pump, but its phase is capable of variation both by hand adjustment and by means of the governor. Each fuel pump is fitted with a lever, which can be used for priming the system, and which ensures that oil fuel is right up to the spraying nozzle before a start is made. Incidentally, this lever can also be used for cutting out the pump while the engine is standing or running.

The fuel-spraying device on the cylinder is quite automatic in its action and needs no levers, cams or rods for its operation. It is merely connected to the fuel pump delivery pipe; when the pressure in the system reaches a predetermined value, the valve opens, and the oil is injected through a special atomiser. The combustion chamber of the engine may be likened to a vertical cylinder flattened at the two sides, and a form of spray has been evolved which suits this shape exactly.

The starting of the new Hick engine is very simple in character. Compressed air is used, and the starting mechanism is clearly indicated by the diagram reproduced in Fig. 382. In the three-cylinder engine under consideration two of the cylinders are fitted with non-return valves A in the cylinder head, while the third cylinder has no starting gear whatever. These two valves are connected to the starting air junction box B on the end of the engine, which is fitted with two cam-operated valves. C is the fuel pump, D is the control valve, with a connection to the fuel valve fitted to each cylinder. A horizontal shaft F connects the fuel-control valve gear with the starting valve operating gear. This shaft passes through the casing, and is fitted with the lever G, which is also clearly visible in Fig. 380. For starting, this lever is thrown over into its extreme forward position. In this position the cams on the horizontal shaft cut out the fuel pumps to the two cylinders on which the air starting valves are fitted, and throw into gear the mechanism for operating the starting valves. In this position two cylinders work on air and one on fuel, and when the air valve on the storage vessel H is opened the engine starts in the usual way, and compresses the air in the remaining cylinder. As soon as this cylinder fires, the lever is pulled back into its mid position, which cuts out the air starting gear and throws in the fuel pump mechanism on the remaining cylinders. The engine then picks up on fuel, and is ready to carry its full load. To stop the engine, this same lever is pulled back to its rearmost position. It will thus be seen that, apart from priming the pumps and turning on the starting air, the whole of the starting and stopping of the engine is controlled by the movement of a single lever. The pressure required in the air receiver is about 250 lb. per square inch, and this pressure is pumped up by a small air compressor driven from the main shaft, either by a friction clutch or belt. The pressure is so low that in the unlikely event of air being lost it can easily be pumped up by hand.

Governing is performed by a centrifugal governor, driven from the top of the vertical shaft, which is connected to the fuel-control valve operating gear by means of an excentrically mounted shaft. The governor controls the fuel by twisting this shaft according to the load on the engine. The gear is very easy to operate, and consequently there is only a light load on the governor, which enables close speed regulation to be obtained. We are informed that the engine has been thoroughly tested by the makers with various grades of fuel oil, and that it was finally subjected to an endurance trial of seventy-two hours on continuous full load. The engine, we learn, ran extremely well, with no stops, either voluntary or otherwise. At the close of the trial, when the engine was opened up and all the working parts and bearings were examined, they were found to be in very good condition.

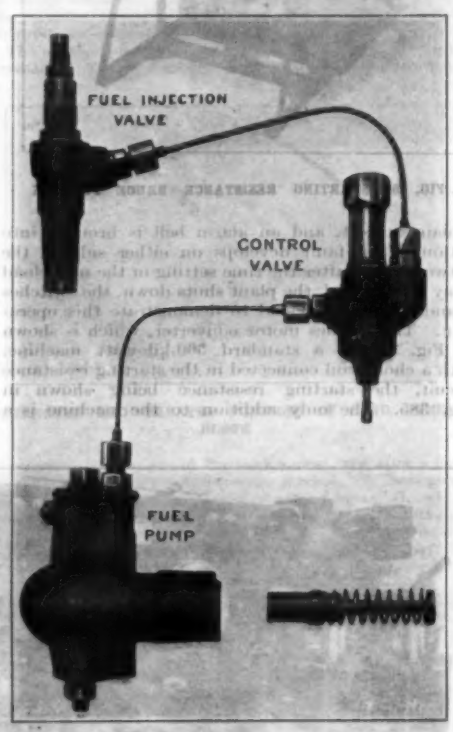


FIG. 384—DETAILS OF FUEL INJECTION SYSTEM

From the description we have given, it will be recognised that this new engine is simple in design, and that it possesses novel features, which fit it for the purpose for which it was designed, namely, for operation by unskilled labour of the type usually found in the Colonies and abroad, and for the many purposes for which engines of this type are used.

ELECTRICAL ENGINEERING EXHIBITS.

BRUCE PEEBLES AND A. REYROLLE, LIMITED.

One of the most novel exhibits in the Palace of Engineering is the Peebles-Reyrolle automatic motor converter sub-station equipment, which is to be seen on the stand of Bruce Peebles and Co., Limited, of Edinburgh. On a demonstration panel there are five demonstration switches which start up and shut down the plant and serve to demonstrate the operation of the equipment under high-tension alternating fault conditions and direct-current positive and negative fault conditions. Above these switches there are illuminated signs which indicate the conditions which the network is assumed to have produced. The signs read:—(1) Demand for power; (2) high-tension circuit breaker operates; (3) self-synchronising device operates; (4) machine in synchronism; (5) direct-current supply available; (6) on load positive, on load negative; (7) fault positive, fault negative; (8) on manual operation.

Visitors to the stand may signal a demand for power by holding the start-up demonstration switch

for a period corresponding to the initial setting of the starting up relay, and as the plant runs up the signs 2, 3, 4, 5 and 6 are illuminated in turn. As there is no actual load on the plant after it has run up, it automatically shuts down again, after the time setting of the underload relay has expired, but the plant may also be shut down by operating the "shut down" demonstration switch. Similarly the plant may be shut down by closing the high-tension fault demonstration switch when the equipment will

FIG. 385—STARTING RESISTANCE—BRUCE PEEBLES

remain at rest, and an alarm bell is brought into action. If a fault develops on either side of the network, then after the time setting of the underload relay has expired, the plant shuts down, the switches 4 and 5 being provided to demonstrate this operation. The Peebles motor converter, which is shown in Fig. 389, is a standard 500-kilowatt machine, with a choke coil connected in the starting resistance circuit, the starting resistance being shown in Fig. 385. The only addition to the machine is a

FIG. 386—GEAR FOR SHORT CIRCUITING SLIP RINGS—BRUCE PEEBLES

small three-phase motor—see Fig. 388—which is provided for short circuiting the slip rings when the machine is in synchronism with the supply. This small motor operates the short circuiting device through a worm gear, and is energised from a potential transformer on the high-tension switch panel.

This main high-tension switch—see Fig. 390—which is designed for a pressure of 3000 volts, receives current from the Exhibition power station, and is a standard Reyrolle metal-clad panel. It is equipped with a potential transformer which supplies the energy for the operating devices associated with the plant, and the switch is operated through bevel gearing by means of a small three-phase motor, which is mounted on the switch as shown. Overload protection and no-volt trip gear are provided. The automatic controlling devices consist of 14 relays of a simple electro-magnetic type, enclosed in cases, with glass fronts, as shown in Fig. 386, and a special time delay device, which, together with the time switch are mounted on the front of one of the slate panels. On an adjoining panel there are an ammeter and voltmeter, a reverse current relay, the shunt field regulator, and hand-operated switches for opening and closing the direct-current circuit breakers. The third panel is a standard direct-current machine panel.

The main circuit breakers on this panel consist of two single-pole circuit breakers, which are arranged to operate independently on a three-wire network, and they are suitable for either hand or automatic closing. There is also the starting resistance and small choke coil, and two simple oil-immersed contactors mounted on the resistance frame, one for closing the neutral point and the other for the insertion of the choking coil. This apparatus enables the machine to be controlled entirely automatically.

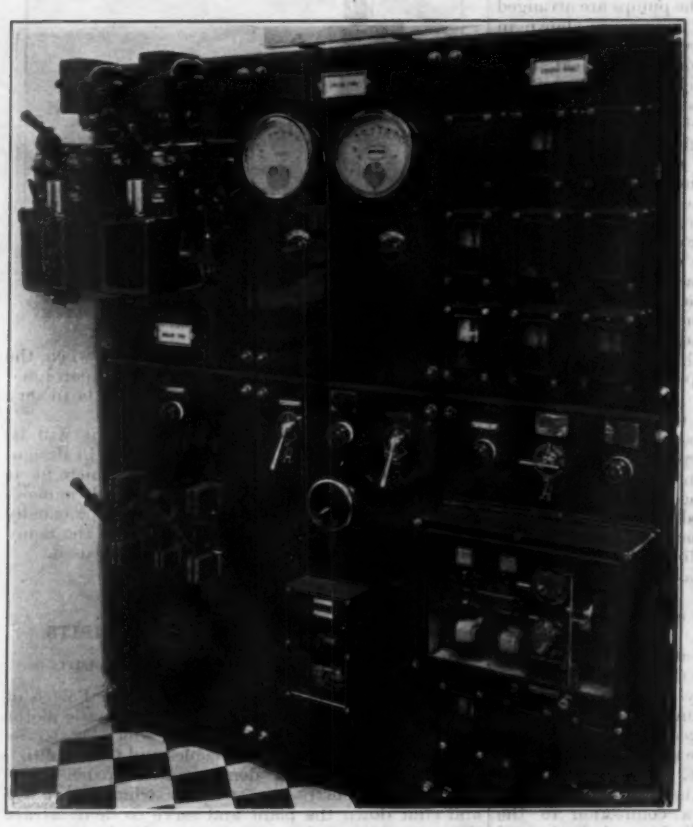


FIG. 388—MACHINE AND CONTROL PANELS—BRUCE PEEBLES

FIG. 387—MULTIPLE TIME-DELAY UNIT—BRUCE PEEBLES

As the result of predetermined conditions, such as a drop in the bus-bar voltage, the set is started after a pre-determined delay, and if for any reason the machine fails to switch on to the load the first time, the starting operations are repeated three times. If the machine still fails to take up the direct-current load it is then locked out of commission. The same applies if the stator temperature rises above a predetermined value, but the plant is automatically put into commission again when the machine cools down. Similarly if the overload relay or bearing temperature device operates the machine is put out of commission. Local and distant warning signals are provided. The equipment can be operated entirely by hand in the station,

and can also be set to come into operation or close down at different predetermined times irrespective of or in conjunction with the load conditions.

The illustration—Fig. 387—shows the multiple

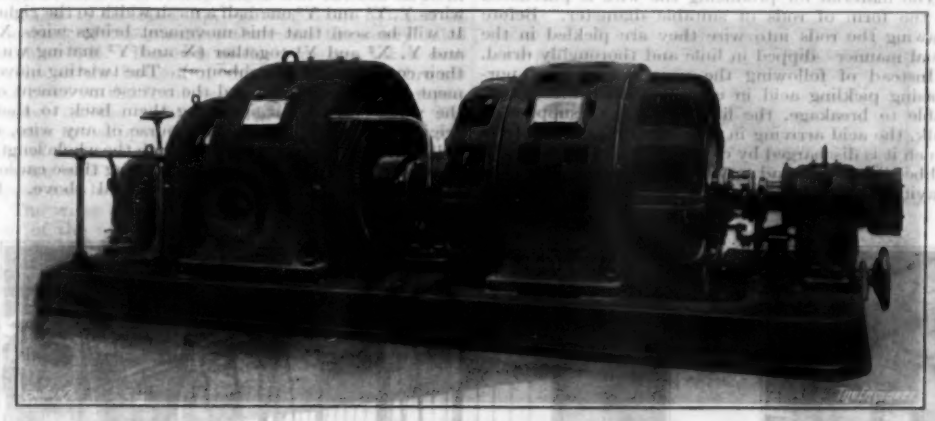


FIG. 389—500 K.W. MOTOR CONVERTER—BRUCE PEEBLES

time-delay device which combines all the time elements required in a single case. The time delay elements employed in the control equipment are

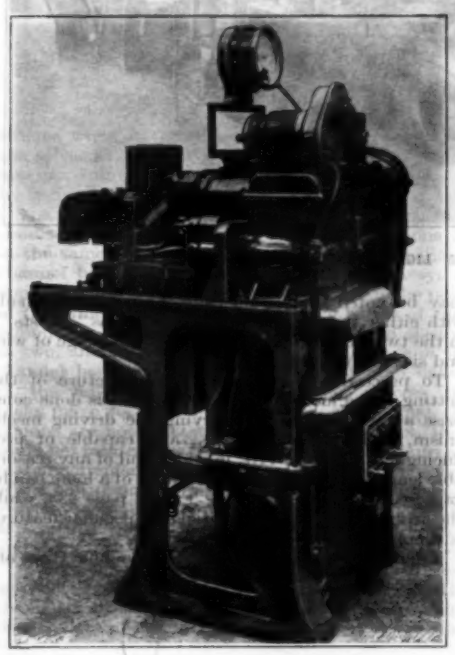


FIG. 390—HIGH TENSION SWITCH PANEL

combined in a multiple time-delay relay which consists of a spindle driven at a constant speed of approximately 3 revolutions per minute by a small

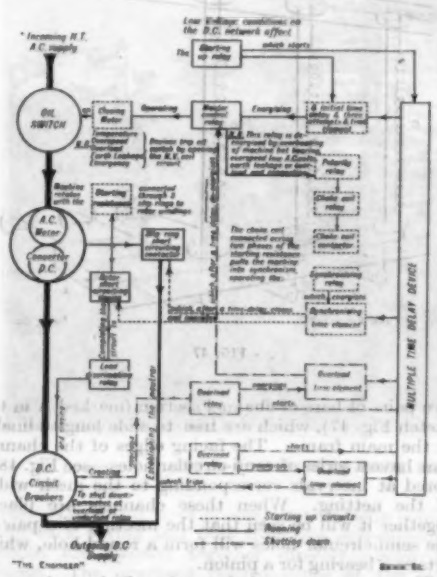


FIG. 391—DIAGRAM OF CONTROL APPARATUS

single-phase motor. Each mechanism consists of a clutch, by means of which a cam or set of cams is rotated and a series of contacts is made or broken in proper sequence after predetermined intervals. The multiple time-delay device embraces the following elements:—(1) The starting up time element, which is adjustable between the limits of 5 and 30 seconds, and which after this period has elapsed continues to operate as the "three-time" starting element, already mentioned; (2) the shutting down element with a similar three-time lock-out feature, which prevents the plant running idle indefinitely; (3) the synchronising time-delay element; (4) the overload time element, which, however, is omitted in lighting equipments, as the device is embodied in the standard slow-speed circuit breakers; and (5) the hand-operated re-setting mechanism. The circuit breaker used on this particular plant is of the type adopted for three-wire networks, but for traction work a Reyrolle reactance high-speed circuit breaker would be used to protect the machine under the heavy operating conditions which traction service entails.

A diagrammatic sketch, indicating the various operating devices and explaining their functions, is given in Fig. 391.

SIXTY YEARS AGO.

From time to time we still hear of active attempts being made to mine gold in these islands, sometimes in Scotland, sometimes in Wales, occasionally elsewhere. That gold exists is certain, and that it once existed in fair quantity is probable from the recorded fact that early visitors to our shores found the natives wearing golden ornaments. Sixty years ago, however, the efforts of prospectors were no more successfully rewarded than they are to-day. In a review of the mineral wealth of the United Kingdom, published in our issue of August 26th, 1864, mention was made of the existence of 23 gold mines in North Wales. Returns were available, however, from only two of these mines, and it would seem that these two between them produced in the year 1863 only 552 oz. of gold valued at £1747. "These results," we find it written, "after all the excitement about British gold mines which has been rife during the past four years, leading to the expenditure of very large sums of money upon the hills of Merionethshire, should read a lesson to our eager adventurers." In the same article it was recorded that in 1863 we obtained from the tin mines of Cornwall and Devon 15,157 tons of tin ore, yielding 10,006 tons of metallic tin. This output was described as being larger in all probability than any ever before produced in the two counties, and, taken in conjunction with the fact that the mines had been worked for more than 3000 years, as indicative of the richness of the district. Our imports of tin during the same year, principally through Holland and from Singapore, amounted to 2728 tons of tin and 559 tons of tin ore. How different is the position to-day may be judged from the fact that the Cornish and Devon mines are all but idle, while our imports are in the neighbourhood of 34,000 tons a year. An interesting fact about the celebrated Dolcoath Mine was mentioned in the article. Like many others it was originally confined to shallow workings, for after a certain depth was reached the miners struck "the yellows," by which they meant copper ore. The belief became firmly established that the tin deposits were confined near the surface, and the copper ore not being apparently desired, many of the workings were abandoned. At Dolcoath, however, the miners had penetrated through "the yellows," and had again come across rich deposits of tin, which in 1863 had produced 1026 tons of ore valued at £69,741. The surface deposit belief had, therefore, it was remarked, been exploded.

An article in a recent issue of *The Times* reports that the railway companies have greatly reduced the pilfering evil, which had reached an alarming state soon after the war. In 1920 one of the leading companies had 103,500 cases of pilfering reported, but by last year this had been reduced to 32,877 for the whole of the companies in the group of which it was a member. The article in question fails to mention one important point which has helped to reduce the evil. This has been the co-operation of the men's unions. The latter informed the railway companies that they considered that pilfering reflected on themselves, and they would do all that was possible to put a stop to it.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

SHINGLE BEACHES AND THE WEAR OF CONCRETE.

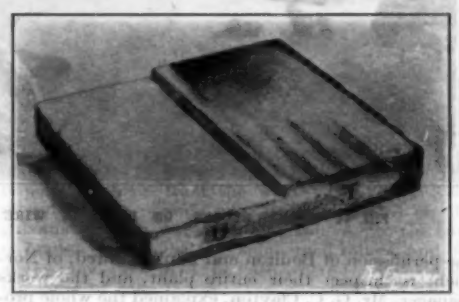
Sir,—I have read Dr. John S. Owens' contribution with great interest. Dr. Owens drew attention to the destructive effect of the grinding action of shingle or boulders upon the surface of concrete, and described some interesting experiments which he had carried out with the idea of providing a concrete surface which:—(*a*) Would resist the abrasive action of the shingle as much as possible consistent with limitations as to cost; and (*b*) would permit of easy renewal when worn.

I would like to draw attention to a very cheap process of "case-hardening" concrete surfaces and rendering them resistant to abrasion, which, in my opinion, should be of considerable interest to all engineers whose work entails the construction of concrete on foreshores.

The process referred to is the treatment of concrete with a dilute solution of neutral silicate of soda. The hardening effect of "waterglass" upon concrete has been known for many years, but the process has not been wholly successful owing to the fact that the correct type of silicate of soda has not been employed, and it has not been realised that in order to obtain beneficial results a very dilute solution of silicate of soda must be used so that penetration into the concrete can take place.

There is now on the market a type of silicate of soda containing a much higher proportion of silica than the ordinary waterglass of commerce. When concrete is treated with a dilute solution of this so-called "high ratio" silicate, colloidal silica and calcium silicates are precipitated within the pores of the concrete, and form a mortar which hardens and binds the particles of sand and cement together to form a remarkably resistant surface.

The photograph herewith illustrates the effect of the silicate treatment. This sand-cement block was made from two parts



UNTREATED AND TREATED PORTIONS OF SAND CEMENT BLOCK

of standard sand to one of Portland cement, and after a fortnight's curing, the half of the service marked "T" was given three coats of a dilute solution of silicate of soda. The whole surface of the test piece was then subjected to severe abrasion under a moving steel block, sharp sand being fed between the steel and the surface of the slab. It will be seen that the untreated half of the test piece has worn away considerably, whereas the treated half has remained almost unaffected.

The silicate process is very cheap, the raw materials costing from ¼d. to ½d. per square yard, and there is no doubt that concrete surfaces can be rendered very resistant to the grinding action of shingle and boulders by such treatment. The treatment can be easily repeated when necessary.

Concrete roads in this country are being treated in this way, and some remarkable results are being obtained.

A silicate treatment would also tend to prevent sea water penetrating the concrete, and would thus alleviate the trouble due to the interchange between the magnesium salts in the sea water and the calcium salts in the concrete, reactions which are largely responsible for the disintegrating effect of sea water.

August 19th. L. A. Mumbo.

STEAM V. ELECTRICITY IN INDUSTRY.

Sir,—Mr. R. H. Lupton's technical and economic defence of the independent plant, as set out in the letter which appeared in your issue of August 22nd, should constitute a full answer to the frame of mind that urges electrification in and out of season as the panacea for all human ills.

It is perfectly clear that in countries such as Italy, Switzerland, Norway, &c., the natural water power calls for exploitation and that electrical schemes follow as an equally natural corollary. At home coal is our indigenous fuel, and if it can be converted into energy directly with the same economy in direct-acting reciprocating engines why sink useless capital in the more elaborate and complex power schemes so dear to the politician at the moment.

But there is an even more serious aspect, if, as some aver, we are not out of the wood entirely so far as either internal or external warfare may be concerned. To electrify our transport or other essential industries extensively is to play directly into the hands of sabotage or enemy action, for the paralysis following the destruction of an independent power station is local, but that following the destruction of a central station such as is contemplated is far reaching in effect, and no doubt our military advisers will for that reason have their word to say on any such general scheme as is under discussion. This clearly applies as much to main line electrification as to water supply facilities.

By all means let us seek to eke out our coal by reasonable resort to natural sources of power for the generation of current, but to embark millions in a Severn barrage scheme, for example, with the object of scrapping independent stations is, as Mr. Lupton points out, at the close of his letter, a most unwise course to pursue. And to those who think that what is right for Italy or Switzerland must also be right for this country, it may also be pointed out that in the water power countries the generating stations are for the most part amongst mountains, which would render aeroplane attack particularly difficult, while in this country our large stations would have no such natural defences.

Bawtry, August 24th. S. P. Christie.

British Wire-drawing and Wire-working Machinery.

No. VII.—WIRE NETTING MACHINERY.*

Among the heavier types of wire-working machinery, one of the most fascinating to watch at work is that used in the manufacture of ordinary wire netting such as is used for poultry-houses, kennels, and fencing of all kinds.

There are only a few factories in this country where wire netting is made on any considerable scale, and the manufacturers naturally do not care to publish too many details of the processes and machines employed; but we were fortunate enough to secure the permission of Boulton and Paul, Limited, of Norwich, to inspect their entire plant, and the works manager, Mr. G. C. Clayton, explained the whole process. In view of the fact that a large proportion of the machinery installed was made in the firm's shops to designs by its engineers and not made for sale, we could not secure detail drawings. The rough sketches in this article will, however, help to elucidate the principles of the wire netting weaving machine, which is by far the most interesting unit involved in an extensive process. The sketches do not, of course, pretend to be to scale or accurate in detail, but they indicate the essential and peculiar features.

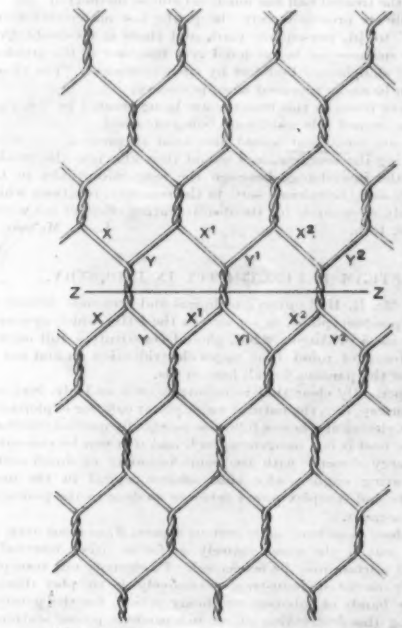


FIG. 46

Before describing the weaving machine, however, it may be as well to give an outline of the preliminary stages through which the wire goes in the Norwich works.

Until comparatively recent times the firm was in the habit of procuring from outside sources the whole of the wire needed—some 250 tons per week. In view of the quantity required, a complete wire drawing plant for producing a large proportion of the wire needed has, however, been put down. Figs. 44 and 45 are views in the wire drawing shop. It is unnecessary to describe this plant in detail as it conforms to modern practice, but a noteworthy point is that a separate motor drive is employed for each wire drawing block, except in the very smallest sizes.

The material for producing the wire is purchased in the form of rods of suitable diameter. Before drawing the rods into wire they are pickled in the usual manner—dipped in lime and thoroughly dried.

Instead of following the usual practice of purchasing pickling acid in carboys, which are always liable to breakage, the firm obtains its supplies in bulk, the acid arriving in railway tank wagons, from which it is discharged by compressed air into a special rubber-lined overhead service tank. The acid is then gravity fed to the various points required, thus eliminating waste, time in handling, and danger to the employees.

FIG. 44—HEAVY BLOCKS, ON LEFT, IN WIRE DRAWING SHOP

FIG. 45—LIGHT WIRE-DRAWING BLOCKS

There are two types of powerful "breaking-down" machines in the wire drawing department and a large number of smaller blocks for producing the various gauges of wire required, which is classed on the metric system, a variation from the nominal dimensions of not more than 0.03 mm. being permitted on the diameter of the wire. The coils of drawn wire are taken on electric trucks to a store at the end of the weaving and filling shops, and a large stock is kept on hand so that the production of finished netting is not held up through shortage of materials.

The first step in the actual process of making wire netting is carried out in the filling shop—Fig. 53 page 238—where half of the wire is wound into "springs" and the remainder is wound on to steel plate bobbins. The "springs" take their name, not from the fact that they are springy, but because they resemble a helical spring wound several layers thick. The springs are about 3ft. long and vary in diameter and number of layers according to the gauge of the wire and the mesh size of the netting to be made.

The springs are produced on a machine having four horizontal spindles geared together and belt driven from an overhead line shaft. The spindles are slightly tapered and the first layer of wire wound upon them is loosened by a simple device. This layer is then squeezed up longitudinally between two movable collars on the spindle; the remaining layers are then wound as required. When the spindles are filled the machine is stopped and the spring drawn off by hand. The machines run at a high speed and are semi-automatic in action, the wire being fed to and fro by means of a screw so geared as to close-wind the wire and which reverses at predetermined points as the ends of the spindle are reached. A fair average size of spring carries about ten turns or layers, is 1¼in. diameter and weighs approximately 8 lb.

The bobbins, which are of sheet steel, are filled, six at a time, on a simple winding machine which has similar characteristics to the spring machine and needs no comment. Stocks of springs and bobbins suitable for all sizes of netting are held in store and are withdrawn as required by the weaving department.

The weaving machine is a most ingenious piece of apparatus, as has already been mentioned. It embodies a quite peculiar piece of mechanism, which, it is hoped, the following sketches will help to elucidate.

First, however, it may be best to scan the actual structure of the netting as a help to a proper understanding of the weaving mechanism. The point which it is necessary to emphasise here is that each mesh is produced by the twisting together of two adjacent wires.

In order to follow the somewhat peculiar motion of the wire the sketch Fig. 46 has been prepared from an ordinary piece of netting. X, X^1, X^2 represent wires coming from the springs, and Y, Y^1 and Y^2 wires fed from the bobbins. Assume that the machine has just twisted the wires together at the points along Z Z, the correct position for the next twisting operation is produced by causing the wires X, X^1 and X^2 to be moved one-half a mesh width to the left and the wires Y, Y^1 and Y^2 one-half a mesh width to the right. It will be seen that this movement brings wires X^1 and Y, X^2 and Y^1 together (X and Y^2 mating with their corresponding neighbours). The twisting movement is now performed and the reverse movement of the wires carried out, bringing them back to their original positions. The mean course of any wire, it will be noticed, runs straight through the whole length of the netting, the only deviations being those caused by the half-pitch movement described above. It may be noted in passing that the netting is made with either two or three turns (known as "twists") in the twisted portion, according to the gauge of wire and size of mesh adopted.

To proceed with the actual manufacture of the netting. The looms on which the work is done comprise a rigid framework carrying the driving mechanism, springs, bobbins, &c., and capable of producing netting up to 11ft. in width and of any reasonable length. The general appearance of a loom can be gathered from the engraving Fig. 54 page 238, while the arrangement of the essential and peculiar features is represented in the sketches.

Running across the width of the machine there are two pairs of bars of channel section (marked A in the sketch Fig. 47), which are free to slide longitudinally in the main frame. The facing edges of the channel bars have a series of semi-circular holes—see Fig. 48—bored at intervals corresponding to the mesh width of the netting. When these channels are placed together it will be seen that the meeting of a pair of the semi-circular holes will form a round hole, which acts as a bearing for a pinion.

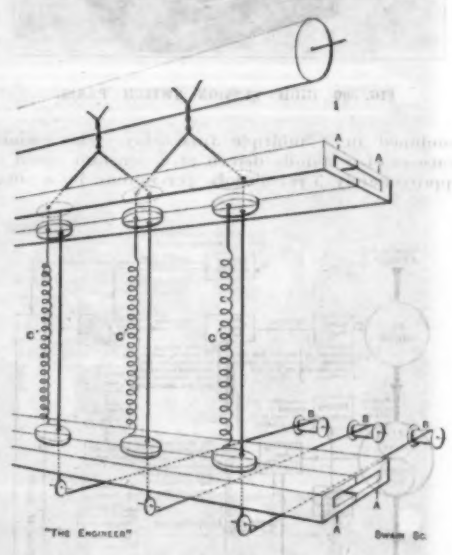


FIG. 47

The arrangement of the pinions is best shown in the sketch, Fig. 51, from which it will be seen that each pinion is split across its diameter in the same plane as the joint made by the channel bars. The pinions are rotated by a long rack engaging with them all, the rack being reciprocated by a crank

* No. VI. appeared August 22nd, 1924.

movement. The movements of upper and lower channel bars, with their respective racks, are synchronised. This sketch also indicates a hole drilled axially through each half pinion, for the passage of the wire, and the disposition of the spring tube or casing between the channel bars.

Now, returning to Fig. 47, it will be seen how the machine is threaded up. Arranged on a frame at the back of the machine there are the ready filled bobbins B B. The ends of the wires are taken over guides at the bottom of the frame and up through the holes in the front half pinions, which are represented on the right-hand side of Fig. 51. The springs are slipped into their tubular cases, the free end of the wire passed through the hole in the upper pinion, and the case secured by the spigots on the upper and lower pinions.

The wires are then led over a pegged roll at the top of the machine, which is driven at the proper speed to produce, in conjunction with the peg spacing, the correct mesh. Means are provided for maintaining an even tension on the various wires, so that the netting may be "dead flat." The

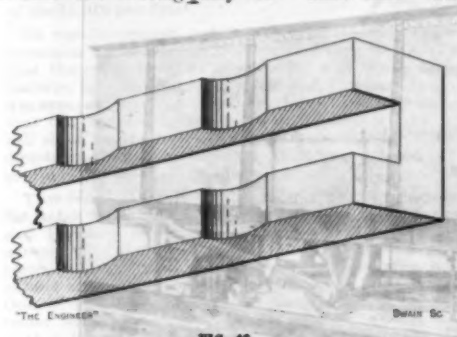


FIG. 46

twisted wires at the edges of the netting—known as the selvedge—are fed into the machine in a similar manner from bobbins, but are not accompanied by springs.

The action of the machine is as follows:—At a time when the joints between the half pinions lie in the same plane as the joint between the pairs of channel bars A A, the bars are moved endways in opposite directions, a distance equal to half the pitch of the pinions. As a result, the two halves of each pinion are separated, just as if they were sheared in two, and slide along against the plain face of the channel bars, until they come opposite the halves of the adjacent pairs. During this process the racks move together with the channels, so that the pinions are not rotated. As a matter of fact, they could not rotate since they have semi-circular journals in semi-circular bearings. The change in position of the half pinions is plainly shown in the diagram—Fig. 52—in which the top row represents the positions at starting, the second row those after one stroke, and so on.

When the half pinions have been mated with their new partners the racks are reciprocated, while the channel bars are held stationary, to such an extent that the pinions make two, or three, complete revolutions. The result is, of course, that the wire coming from each spring and that from the corresponding bobbin are twisted together directly above the pinion. The overhead pegged roller at the same time draws the netting forward at such a speed that the meshes formed engage with the pegs. The channel bars are returned to their original positions, so that the half pinions are re-mated with their original partners and the whole process is repeated.

It will now be seen why half the wire is wound as springs and half as bobbins, as if all the wires were on bobbins the strands would naturally become twisted together below the lower channel bars, making it impossible to feed the wire forward. It

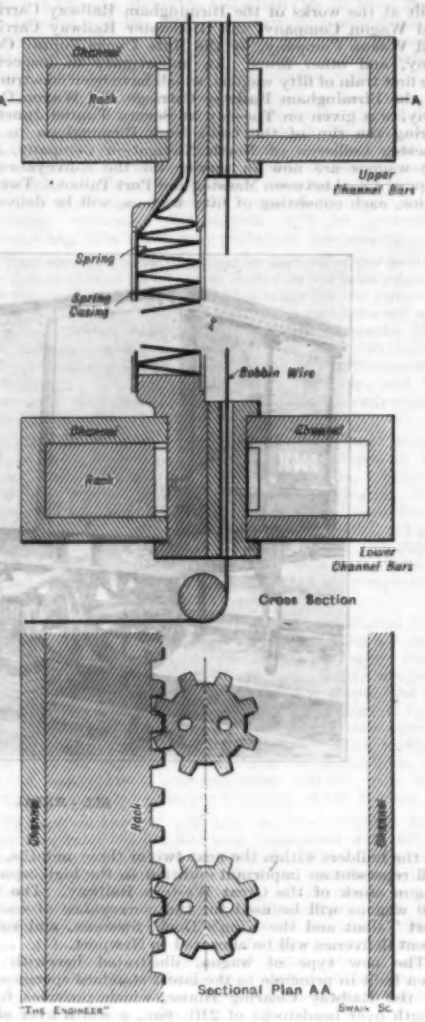


FIG. 51

would, of course, be possible to work with two springs and no bobbins if there were room for their accommodation; but the arrangement adopted allows the case for the spring to overlap the half pinion for the bobbin wire and consequently permits a much greater length of wire to be made up into the spring.

From the above description it will be readily appreciated that all the parts of the looms have to be made with a high degree of accuracy, especially the channel bars, racks, and pinions, the latter having to be truly interchangeable. At the same time the whole mechanism has to be very substantially constructed to withstand the heavy stresses imposed on it; as an average set of springs weighs about 500 lb. and, in addition to this, there is the combined weight of racks, channel bars, spring cases, and pinions, all of which has to be reciprocated at a rate of about 60 strokes per minute, while the strokes must be exact in length or the half pinions will not register sufficiently accurately to rotate in their split bearings.

Some of the machines are set up for weaving netting with a mesh of only ¼in., and in such cases the workmanship has to be of a very high order, as the dimensions of the several parts are so small.

A complete engineering staff is maintained for the purpose of keeping the whole plant in a state of maximum efficiency, and experiments are continually being made with a view to improving the construction and operation of the machines.

At the Boulton and Paul works the black netting—that is, netting direct from the looms—is taken from the weaving department and put into a large store, where stocks of all the various sizes are accumulated, and it is not until an order is actually received that the netting is galvanised, thus ensuring that the customer receives it fresh from the galvanising bath.

The rolls of netting are taken, as required, to the

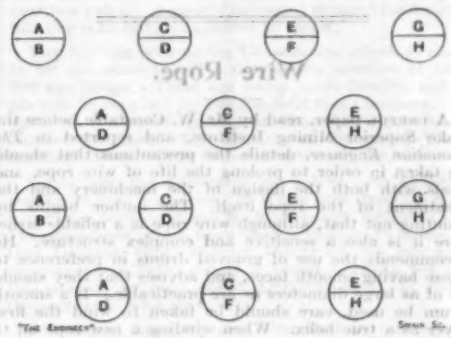


FIG. 52

galvanising shop—Fig. 49—where they are dipped bodily into an acid pickling bath to clean them and remove all scale from the wire. The roll is then mounted on a spindle in a framing carried on the galvanising bath and is fed over rollers into the bath of molten zinc, under two submerged rollers, and out at the opposite side of the bath where there is a floating layer of coke breeze, through which the netting is drawn. This breeze serves to remove all surplus metal from the wire. The netting is then re-wound on a specially designed machine, and is ready for home order despatch. It should be pointed out that when the photograph of the galvanising shop was taken the hoods for carrying away the fumes from the baths had been removed, as they obscured the view. As a matter of fact this shop is notable on account of the clearness of its atmosphere.

In the case of export orders, however, the netting is again re-rolled, in order to make the rolls as compact as possible, and so save freight.

The machines for this re-rolling, known as tight winders, consist of three parallel rollers with a loose spindle at the centre of the group—see Fig. 50.

FIG. 49—GALVANISING WIRE NETTING

FIG. 50—TIGHT-WINDING NETTING FOR EXPORT

The netting is attached to the centre spindle, and is wound under the pressure of the three rollers, which gradually recede from their common centre as their bearings move along scroll-shaped slots in rotatable end frames. The pressure on the rolls can be varied at the will of the operator by a form of friction gear. The result is a very solid roll, which saves a considerable amount of freight as compared with

the roll as it comes from the galvanising bath.

The foregoing is really only a very cursory description of the general process of making wire netting, but before leaving the works of Boulton and Paul, it may be worth while to mention a simple machine installed in the scrap yard. The machine in question is used to bundle the scrap wire from the various netting shops, and is made by the Stonehouse Works Company, of West Bromwich. It comprises a horizontal spindle driven by belt through powerful gearing and running between two housings, like a rolling mill. Above the spindle is a heavy roll with its axle running in vertical slots in the housing, so that it can rise and fall. The scrap is shovelled on to a shoot in front of the machine and the spindle started. When once the spindle has gripped the scrap, it drags it in, rolling it up with the spindle in the centre, the heavy roll above compressing the mass. When the machine is full, the bundle of scrap is wired round to prevent disintegration, the spindle withdrawn by a lever and ratchet, and the bundle rolls out from the machine. The bundle is about 21in. long by 15in. diameter, and weighs approximately ¾ cwt., while about 3 horse-power is required to drive the machine.

Wire Rope.

A USEFUL paper, read by Mr. W. Constable before the Lake Superior Mining Institute, and reported in *The Canadian Engineer*, details the precautions that should be taken in order to prolong the life of wire rope, and deals with both the design of the machinery and the treatment of the rope itself. The author begins by pointing out that, although wire rope is a reliable structure it is also a sensitive and complex structure. He recommends the use of grooved drums in preference to those having smooth faces, and advises that they should be of as large diameters as are practicable. If a smooth drum be used, care should be taken to wind the first layer as a true helix. When winding a new rope on to a smooth drum there should be no hard hammering of the wraps of idle rope against the adjacent wraps already on the drum; only tapping with a light hammer and a wooden block. When more than one layer of rope is used on a grooved drum, the grooves should be neither more nor less than ¼in. larger than the rope, and they should be of a slightly larger radius than the rope. In present-day practice the drum diameter is not less than sixty times the rope diameter.

If a cast iron sheave wears so much as to influence the life of a rope, a cast steel sheave should be used, and if a cast steel sheave wears so much as to influence the life of the rope, a manganese steel sheave should be used, if operating conditions permit. The sheave must be in line with the centre of the drum, or with the centre of the portion of the drum on which the rope winds. For high-speed hoists the head sheaves should be as light as possible, to prevent slip. For new and for re-machined sheave grooves the following diameters are recommended:—For ¾in. to 1¼in. diameter rope, $^1/_{16}$in. larger; for $1^3/_{16}$in. to 2¼in. rope, ⅛in. larger; for 2½in. diameter rope and upwards, $^3/_{16}$in. larger. The usual diameter for a sheave is 72 times the rope diameter, but 80 times is better.

The "fleet angle" should be kept as small as possible; the usual allowance is 1½ deg. to 2 deg., but where a small diameter straight-faced drum is used a maximum fleet angle of 1½ deg. is excessive. The life of a rope may be shortened by 30 to 50 per cent. by reason of too large a fleet angle. Clips should be spaced six rope diameters apart from centre to centre, and their nuts should be tightened frequently.

During shut-downs ropes should be kept wound on the drums and not left dangling nor trailing. In inclined haulage work knuckle sheaves of not less than 48 times the rope diameter for 6 by 19 construction, nor less than 84 times for 6 by 7 construction should be provided at points where the change of direction of the rope is such that the length of the arc of contact is six times the rope diameter or more.

In both hoisting and hauling, undue acceleration and overloading should be avoided, and for a short rope the safety factor should be increased. On excavating shovels the ropes may easily be damaged by reckless handling. On such machines the drum should take the whole of the rope in one layer. In handling wire it should not be uncoiled like a hemp rope, but should be unrolled like a hoop and straightened out before it is passed round the sheaves, and care should be taken to avoid kinking.

20-Ton Wagons for Coal Traffic.

DELIVERY has now been made of the first fifty of the 20-ton wagons of which one thousand have been ordered by the Great Western Railway, and which are being built at the works of the Birmingham Railway Carriage and Wagon Company, the Gloucester Railway Carriage and Wagon Company, by the Bute Docks Supply Company, and other firms. An opportunity of inspecting the first train of fifty wagons, which have been constructed by the Birmingham Railway Carriage and Wagon Company, was given on Tuesday at Severn Tunnel Junction during the run of the train from Birmingham to the Maesteg Collieries of North Navigation Company, and the wagons are now in service for the conveyance of shipment coal between Maesteg and Port Talbot. Twenty trains, each consisting of fifty wagons, will be delivered by the builders within the next two or three months, and will represent an important addition to the high capacity wagon stock of the Great Western Railway. The first 500 wagons will be used for the conveyance of coal to Port Talbot and the King's Dock, Swansea, and subsequent deliveries will be allocated to Newport.

ALL-METAL 20-TON COAL WAGON

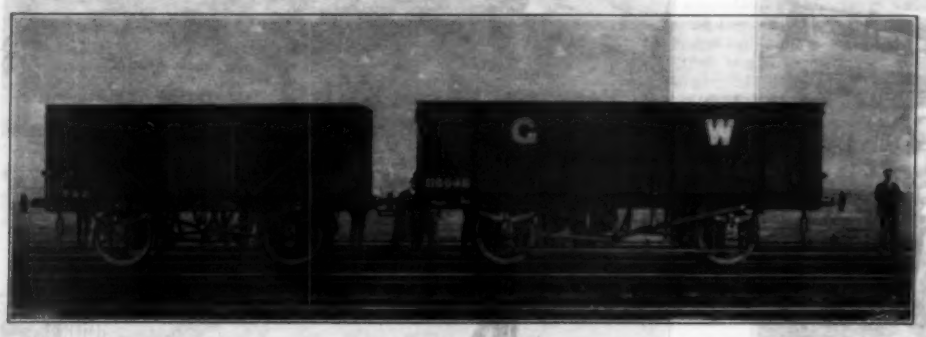
The new type of wagon, illustrated herewith has been built in principle to the latest standard specification of the Railway Clearing House, which provides for a length over headstocks of 21ft. 6in., a width over all of 8ft. 6in., a wheel base of 12ft., a height in the case of timber wagons of 9ft. 7in., but subject to modification in metal wagons; a space of 5ft. 8in. between centres of buffers, a height of buffers from rail in the unloaded condition of from 3ft. 5in. to 3ft. 6in., and maximum tare of 8 tons 10 cwt. Side doors when down must clear the rail level by 8½in., and bottom doors by 7in. with the wagon in the unloaded condition.

The Great Western wagons—for which contracts were placed before the Clearing House specification was finally passed and issued—vary in details only from the approved design The dimensions are:—Length, 24ft. 6in.; width overall, 8ft. 6in.; height from rail, 8ft. 8in.—a reduction due to the adoption of all-metal construction, which accounts for the slight addition to the length of the wagon—and wheel base, 12ft. A special feature is the provision, not of bottom doors, but of a tip door at both ends, to avoid the necessity of having to turn wagons on arrival at the hoists. The tare, owing to metal construction, ranges from 9 tons 6 cwt. to 9 tons 11 cwt., and is, therefore, rather high. Several of the principal firms of wagon builders are already equipped with suitable plant for producing the new standard 20-ton wagon, whilst in other cases preparations are being made to this end, and especially in view of the obvious advantages possessed within the Bristol Channel area for assembling the necessary material, it is anticipated that more extensive facilities will before long be available for the production of these high capacity wagons in South Wales.

It was the original intention of the Great Western Railway management to induce private owners to build 20-ton wagons for the South Wales coal export trade, and it will be recalled that last autumn the company made an offer of a rebate of 5 per cent. off conveyance rates on all coal class traffic conveyed wholly over the Great Western system in fully loaded 20-ton wagons. For various reasons, mainly due to a desire to obtain a larger rebate, an application for which has been definitely refused, nothing was done by private interests, and the management of the Great Western Railway, impressed with the advantages of high capacity wagons, as the result of experience gained with the 1800 wagons of from 20 tons to 40 tons capacity now in service for the transport of locomotive coal, decided to embark on a building programme, and to hire out the 20-ton wagons on a tonnage basis, the rate varying from 5d. to 3d. per ton, according to the number of trips made within a given period. Colliery proprietors, coal shippers and wagon hirers are co-operating with the railway company, the hirers including North Navigation Collieries, Messrs. D. R. Llewellyn, Merrett and Price, Bedwas Navigation Company, Crumlin Valley Collieries, Limited, Bradbury, Son and Co., and the Cory interests. The time is believed to be approaching when throughout the South Wales area the 20-ton wagon will predominate for coal shipment requirements.

With regard to the capital cost of the high capacity wagon, it is stated that the prices quoted for two 10-ton coal wagons are 50 per cent. more than the price of a 20-ton wagon. Economies realised in service include a saving of about 30 per cent. in siding space, which should obviate the need of laying down new sidings in many cases—a reduction in shunting costs due to the smaller number of wagons to be handled, and a saving in maintenance charges. Haulage costs should also be reduced, as there is in comparison with trains of 10 and 12-ton wagons a saving in the dead load. More important still is the increase in the rate of shipment which would be associated with the general use of the 20-ton wagon.

The work of reconstructing the coal-handling equipment at South Wales docks and of making the necessary alterations at the pits is now in hand. By keeping the height of the new wagon down to 8ft. 8in. the cost of effecting changes at the collieries has been simplified, and the 20-ton wagon can be handled at many of the pits almost without any changes being made in the arrangement for loading the wagons. The task of reconstructing existing hoists at the docks and of installing new high capacity hoists will prove costly, but it is being taken in hand vigorously, and a sum of £2,200,000 has been allocated for the necessary work at the docks. It is expected that a considerable addition will be made during the next few months, concurrently with the delivery of the wagon stock, to the number of hoists capable of dealing with 20-ton wagons. It is estimated that when the reconstruction work is completed, and the new hoists, which are being supplied, among other firms, by Sir W. G. Armstrong, Whitworth and Co., are installed, the shipment capacity of the South Wales coal docks will be raised to 50,000,000 tons a year. The maximum recorded in past years was 40,000,000 tons in 1913. It is understood that newer methods of shipping coal are under consideration, and that experiments are to be carried out with a modified form of belt conveyor and bucket loader.



OLD AND NEW TYPES OF COAL WAGON

ACCORDING to the Board of Trade returns the value of the railway material exported during the first half of the present year was as follows, the corresponding figures for 1922 and 1923 being added in brackets:—Locomotives, £1,115,254 (£1,571,021, £2,992,054); rails, £916,118 (£1,193,792, £1,525,330); carriages, £558,954 (£589,292, £860,791); wagons, £1,805,716 (£1,521,657, £2,023,145); wheels and axles, £332,285 (£261,324, £239,973); chairs and metal sleepers, £788,128 (£491,811, £1,224,924); miscellaneous permanent way, £652,556 (£572,544, £824,512); total permanent way, £3,144,144 (£3,128,699, £4,670,121). The weight of the rails exported was 102,218 tons (133,798 tons, 147,332 tons), and of the chairs and metal sleepers, 62,267 tons (44,154 tons, 88,805 tons). During the month of June last locomotives to the value named were shipped to the following countries:—India, £49,284; South Africa, £15,594; the Argentine, £12,933; and rails as follows:—The Argentine, £41,625; British West Africa, £22,985; Chili, £3781.

Railway Matters.

THE rare event of a coupling-rod breaking took place on the evening of the 16th inst. to the engine of a passenger train on the Midland section near Ashby-de-la-Zouch.

THE Cairo correspondent of *The Times* understands that it is proposed to unite Cairo with Suez by a standard gauge electric railway across the desert. The distance will be covered in two hours, as compared with the present six hours, *viâ* Zagazig and Ismailia.

THE Great Western Railway Company sought powers during last session to make certain alterations at Saltney, near Chester. These having been sanctioned, the company is putting the work in hand at a cost of about £50,000 in order to provide for the Royal Show next year.

THE general manager of the Great Western Railway, Sir Felix Pole, points out in the *Great Western Railway Magazine* the excellent standing that company had in the matter of accidents to railway servants last year. In "movement" accidents it had only 21 of the 194 fatal cases, and 592 of the 3382 non-fatal, and in "non-movement" accidents 3 of the 36 fatal and only 1945 of the 15,016 non-fatal.

IN our description last week of the Hendon-Edgware extension of the London Electric Railways we mentioned that the reconstruction of the City and South London Railway between Moorgate-street and Clapham Common was approaching completion. It is now officially announced that the line will be re-opened on December 1st. That will allow for the trains from the Edgware and Highgate directions that now terminate at Moorgate-street to be continued to Clapham Common.

THE Hull Chamber of Commerce, having written to Sir Ralph Wedgwood, as to the closing of the former Hull and Barnsley locomotive works at Hull, has received a reply that the decision was unavoidable. There was considerable economy to be made by concentrating heavy repairs at the company's principal shops in Darlington. One of the main purposes of amalgamation presented under the Railway Act was the effecting of economies so that the rates might be reduced to the lowest possible figure. That object would be defeated if local considerations were to stand in the way.

SOME fuller particulars are now available as to the local celebrations, mentioned in this column on July 4th, of the railway centenary next year. It is intended to hold the celebrations as far as possible at Stockton and Darlington. The first day's proceedings will take place on July 2nd, and will probably include the unveiling of a tablet in Bridge-road, Stockton, where the first railway ticket was issued, a luncheon at Stockton, a procession of representative locomotives and rolling stock from Stockton to Darlington, and a banquet at Darlington. It is proposed to invite members of the International Railway Congress, which will be held in this country next year, to attend the celebrations. An exhibition illustrative of railway development during the past hundred years will be opened at Darlington on July 3rd for a fortnight.

THE National Industrial Conference Board of New York has recently investigated the trend of wages, hours and employment of railway labour as a whole from the 1914 period to the end of the first quarter of this year. It was found that the average hourly earnings of all railway workers were 60 cents—say, 2s. 9d.—or 136 per cent. greater than in 1914. The purchasing power was 30 per cent. greater than in 1914. Comparison is made between the pay in railway shops and in foundries and machine shops. In 1914 both classes were about equally rated; in the first quarter of the present year the pay in private shops was 108 per cent. higher than in 1914, but the railway shopmen were receiving 142 per cent. more. The report adds that enginemen and trainmen were not as well off as other classes of railway labour.

THE railway companies in the Irish Free State appreciate that their unification is bound to come and that they had better amalgamate under a scheme prepared by themselves than under a compulsory plan drafted by the Government. The Great Southern and Western, the Midland, Great Western and the Cork, Bandon and South Coast have therefore agreed to be the constituent companies in a self-prepared scheme, and the Cork, Blackrock and Passage, the Cork and Macroom and the Waterford and Tramore the subsidiary companies. The whole is to be known as the Great Southern Railway of Ireland. The Dublin and South-Eastern is not a party to this proposal, as it believes that its salvation lies in amalgamation with the Great Northern of Ireland. The latter company cannot join in the unification were it so disposed, as part of its property lies in the Northern area. The Sligo, Leitrim and Northern Counties Company is in the same unsatisfactory position.

ACCORDING to the *Iron and Coal Trades' Review*, new locomotive and carriage and wagon shops, with modern equipments, are being erected at Perambur, near Madras, for the Madras and Southern Mahratta Railway. An expenditure of upwards of £2,000,000 has been recently sanctioned by the Secretary of State for India for the purpose. The chief engineer and locomotive superintendent are now engaged in preparing designs for workshops, equipped with the latest pattern automatic tools. The acting agent of the Madras and Southern Mahratta Railway, and present chairman of the Madras Port Trust, proposes to adapt the powerful block-setting cranes at Madras Harbour, so that, if desired, the broad-gauge locomotives at present under construction in this country may be lifted direct from the ship to the rails ready for immediate service. Similar work is being carried on at Marmagoa, where a suitable powerful crane is already available for landing the metre-gauge engines ready for service, and if this method of importing locomotives should prove economical, there appears to be no reason why all classes of rolling stock should not be similarly sent out to India ready for immediate service. So far as the new workshops at Perambur are concerned, it is thought that they will be very much affected by the success of the proposed scheme to import locomotives and rolling stock in running order, as the extent of workshop accommodation and labour required will be less, by reason of the locomotives being assembled in Great Britain.

Notes and Memoranda.

CANADA produces 88 per cent. of the world's asbestos supply, all from the mines of Southern Quebec.

BRITISH COLUMBIA is now the third industrial Province in Canada, states the Canadian Official Press Bureau in London. It has 2637 manufacturing establishments, with invested capital amounting to nearly 45 million pounds sterling, over 41,000 employees, and producing goods valued at 82 million pounds sterling a year.

THE subject of heat transmission is now being investigated on a comprehensive scale by the United States Engineering and Industrial Research Branch of the National Research Council. The transmission of heat in exhaust-gas heaters for oil engines is assuming a considerable degree of importance. We learn in this connection that the National Research Council—Vernon Kellogg, secretary, Washington—will be pleased to receive any data which may pertain to this subject.

THE cooling power of glycerine and its water solutions as well as that of an oil water emulsion has been examined by the American Bureau of Standards for the purpose of finding quenching media to fill in the gap between water and oil. From experimental quenching curves giving the rate of cooling at the centre of a 1in. cylinder of 32 per cent. nickel steel, it was found that glycerine water solutions accomplish this purpose effectively, and that, moreover, they have characteristics distinctive from those of oil and apparently in their favour.

THE first paper mill in Quebec, states the *Board of Trade Journal*, was established at St. Andrews in 1803, at a time when only rag paper was made. About the middle of the nineteenth century the institution of the process of making paper out of wood pulp presented a new era for the development of the forest wealth, and since then tremendous progress has been made. To-day, of the 104 pulp and paper plants in Canada 54 are situated within the Province of Quebec; in 1923 they represented a capital value of 191,514,809 dollars.

THE volume of testing work done by the United States Bureau of Standards has increased more than a hundred times during the twenty-two years of its existence. During the first fiscal year, up to June 30th, 1902, altogether 1055 tests of all kinds were completed. During the year just closed about 140,000 tests were conducted by all divisions of the Bureau. Most of these tests were executed for other branches of the Government. Much testing is also done for commercial firms and for individuals, over 40,000 test folders, covering over 600,000 such tests, having been issued since the founding of the Bureau.

THE production of pig iron in this country during July amounted to 611,900 tons, compared with 607,800 tons in June and 655,100 tons in July, 1923. The number of furnaces in blast at the end of the month was 174, a decrease of 11 since the beginning of the month and the lowest number in blast since December, 1922. The production included 189,700 tons of hematite, 213,100 tons of basic, 141,100 tons of foundry, and 34,500 tons of forge pig iron. The output of steel ingots and castings amounted to 693,300 tons, compared with 651,500 tons in June, when output was affected by the Whitsun holidays, and 639,500 tons in July, 1923.

SOME exhaustive tests on the effect of using impure water for mixing concrete have been undertaken by Professor Duff Abrams, Professor in Charge of the Structural Materials Research Laboratory at the Lewis Institute, Chicago. He found that in spite of the wide variation in the origin and type of the waters used, and contrary to accepted opinion, most of the samples gave good results in concrete. This result seems to be accounted for by the fact that the quantity of injurious impurities present is quite small. The following samples gave concrete strengths below the strength ratio of 85 per cent., which was considered the lower limit for acceptable mixing waters. Acid waters, lime soak from tannery, refuse from paint factory, mineral water from Colorado, and waters containing over 5 per cent. of common salt.

THE British Broadcasting Company states with regard to the supposed danger from lightning to a house which has a wireless set, that a wireless aerial does not mean additional danger. If anything, it is a protection to a house. If lightning is going to strike a house, it will do it whether there is an aerial there or not. Every aerial should be properly earthed at night, and also on the approach of a storm, which is heralded by violent atmospheric crashes in the telephones or loud speaker. To earth an aerial properly, disconnect the lead-in wire where it enters the house. Disconnect the earth wire from the set. Join the lead-in to the earth wire outside the house if possible. The set will then be isolated from both wires leading to aerial and earth, and there will be a direct connection from aerial straight to earth without entering the house. Hence the advisability of the earth connection being outside the house.

THE Mines Department has published the report of the Safety in Mines Research Board for 1923 showing the position of the research work into mining dangers after a little more than two years' work of the Board. This Board is a very strong body of distinguished mining engineers and scientists. Its work is financed almost entirely by the Miners' Welfare Fund, whose grants for the year 1923 amounted to nearly £44,000. A scientific staff has been established at Eskmeals, Sheffield, and elsewhere, and is carrying on work of the greatest importance to the coal mining industry. The report shows in detail the work undertaken by the Board. Those researches have been taken in hand which are most likely to yield information quickly on the more important problems. With the United States Bureau of Mines a full scheme of co-operation of research into safety in mines has been entered into. Representatives of the Research Board and the Mines Inspectorate have visited the United States and representatives of the Bureau of Mines have visited this country. Definite arrangements have been made for the exchange of staff and for co-ordinated work with a view to avoiding unnecessary duplication and to securing that research work is carried out for both countries where the best facilities exist for doing it.

Miscellanea.

IT is reported from Wellington that an important new coal outcrop has been discovered near the Cascade area, with access to Buller Gorge, on the west coast of South Island, New Zealand. A railway which is projected will tap the new coal field.

THE Swedish Telegrafstyrelsen—Telegraph Board—is requesting the Government's authorisation to erect broadcasting stations at Stockholm, Gothenburg, Malmoe, Sundsvall and Boden, and to conclude an agreement with Aktiebolaget Radiojaenst regarding the management of broadcasting.

REPRESENTATIVES from Tibet have arrived in England to inquire into the possibility of establishing engineering concerns in their country. One of the delegates stated that the Tibetans have very few machines, and that these are all worked by man-power. They have started a brass foundry, with the aid of Europeans, and want more instructors.

IT is reported that a construction company in the United States has undertaken to supply the municipality of Buenos Aires with money to rebuild and develop certain quarters of the city, and that a sum of approximately £10,000,000 is to be spent upon the scheme within the next few years. A greatly increased demand for American building materials is expected to result.

THE lighting scheme for Chapeltown, which is shortly to be commenced, will comprise the erection of nearly 200 gas lamps. These are being made locally, and the gas will be supplied by the Sheffield Gas Company. The agitation for street lighting at Chapeltown goes back a number of years. The districts of Burncross Warren and High Green will be included in the scheme.

UP to date the Admiralty has salved over £5,000,000 sterling in gold bars from the White Star liner Laurentic, which was torpedoed and sunk off Lough Swilly in 1917. The operations, which have been in charge of Commander Guy Damant, Chief Salvage Officer of the Admiralty, commenced in 1918, and it is hoped to finish the work this season, as only about £500,000 worth of bullion remains to be recovered.

THE Orient liner Oronsay, described in our issue of August 22nd, is fitted with a Duct keel. The keel runs from the forward end of the boiler-room to the forward hold, and it houses a large number of pipes which would otherwise have to be run through the holds or double bottom tanks. We understand that the owners have adopted the Duct keel for the third vessel, which was ordered recently from Vickers Limited, Barrow.

ACCORDING to the *Chemical Trade Journal and Chemical Engineer*, a remarkable process is proposed by the A.G. für Stickstoffdünger, in Knapsack, for the de-aeration of boiler feed-water in steam-raising plants where oxygen corrosion is troublesome and where no elaborate arrangements exist for treatment. The process consists in blowing through the feed water a stream of nitrogen gas which displaces the air from solution. If the gas displaced be freed from its oxygen and carbon dioxide by suitable absorption media, the nitrogen can be utilised again and the process made continuous and cyclic.

SATISFACTORY progress, we learn, is being made at Scapa Flow with the salvage of the sunken German destroyers. Cox and Danks, Limited, who have undertaken the work of salvage for the Admiralty, have raised two destroyers in a fortnight, and the firm is preparing to raise a third destroyer this week. It is expected to be able to cover all the main work connected with the raising of similar vessels in a few days. The large battle-cruisers Hindenburg and Seydlitz will not be dealt with this year, as the 24 torpedo-boat destroyers furnish sufficient material to occupy the firm's attention for fully twelve months.

DIVISIONAL engineers have submitted their first general report to the Minister of Roads for Quebec, on the condition of improved local roads. This report, dealing with every improved road in the province, shows that, out of a total of 3200 miles of roads, 2150 miles are in first-class condition, 880 miles are in a fair condition, and 170 miles are still in bad shape. The latter represent 6 per cent. of the above-mentioned total. On the whole, this report denotes a satisfactory state of things and indicates an improvement upon last year. In fact, at the same date in 1923, roads in bad condition still amounted to 8 per cent. of the total.

THERE are two oil-hardening factories in Norway. The smaller of these, which had been closed down for a considerable period, was taken over by Norwegian whaling companies in 1923 and has recommenced production on a small scale, with hopes of extension in the near future. The second factory is reported by Mr. C. L. Paus, Commercial Secretary to H.M. Legation at Christiania, to have worked at normal capacity during the past twelve months and to have exported large consignments of edible fats to Germany and the United Kingdom and of technical fats to Germany. Considerable quantities of both edible and technical fats were also disposed of in Scandinavia. Whale oil was the chief raw material employed.

THE secretary of the Cardiff and Bristol Channel Shipowners' Association states that he has received a communication from the Docks Delays Investigation Committee, which explains that many specific cases of delay have been looked into, and apparently it has been found that the responsibility for any such delays in the shipment of coal cannot be fixed upon any particular section of the commercial community, whether coalowner, dock owner, shipowner, or coal exporter. The Docks Delays Committee states that one of the causes of delay in the shipment of coal is that those in charge of vessels do not always make the necessary arrangements on board so as to ensure that no avoidable delay shall take place, and that cases have been investigated which, it is alleged, show that delays take place owing to no steam being available, to holds having to be prepared after a vessel is in berth, to no candles being available, and to certain other causes for which the ship's people are responsible.

THE WIRE NETTING SHOPS OF BOULTON AND PAUL, LTD., NORWICH

(For description see page 234)

FIG. 53—SPRING-WINDING SHOP

FIG. 54—WIRE NETTING WEAVING SHOP

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The Engineer

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Contents.

The Engineer, August 29th, 1924.	Page
A Seven-day Journal	227
The British Empire Exhibition. No. XIX. (Illus.)	228
Sixty Years Ago	233
Letters to the Editor—	
Shingle Beaches and the Wear of Concrete	233
Steam *v.* Electricity in Industry	233
British Wire-drawing and Wire-working Machinery. No. VII. (Illus.)	234
Wire Rope	236
20-Ton Wagons for Coal Traffic. (Illus.)	236
Railway Matters	237
Notes and Memoranda	237
Miscellanea	237
Leading Articles—	
The French Navy	239
The Treatment of Water Supplies	239
One Hundred Years of British Railways. No. IX. (Illus.)	240
Literature	241
New Sewage Works at Tilbury. (Illus.)	242
Australian Engineering Notes	245
Accidents in American Coal Mines	245
Short Wave Directional Wireless	245
Provincial Letters—	
The Midlands and Staffordshire	247
Lancashire	247
Sheffield	248
North of England	248
Scotland	248
Wales and Adjoining Counties	249
Personal and Business Announcements	249
Launches and Trial Trips	249
Catalogues	249
Current Prices for Metals and Fuels	250
French Engineering Notes	251
British Patent Specifications. (Illus.)	251
Forthcoming Engagements	252
Contracts	252
Paragraphs—	
Tenth Exposition of Chemical Industries	249
American Institute of Mining and Metallurgical Engineers	252

THE ENGINEER.

AUGUST 29, 1924.

The French Navy.

In view of the importance given to manœuvres by all the countries possessing navies, the French feel that they have fallen a long way behind as a naval Power. Until quite recently they have not been able to give attention to the reconstitution of the fighting fleet, which is of little value as judged by post-war standards, and although the programme of naval construction will in time provide a homogeneous navy, the country feels that it is not safe meanwhile from attack. The necessity of a powerful navy has grown since the French increased their North African domain, which is now regarded as a continuation of the Mother Country. The vast fertile territories watered by the Senegal and the Niger are to be brought within easy distance of Marseilles by the construction of railways and the opening up of air services, and the fact that the Mediterranean is the centre of this vast Empire has impressed the French with the importance of keeping it under their own control if they are to maintain the Empire intact. Africa is expected to supply France with ample raw material and man power, and there must be no danger of those supplies being intercepted by a hostile fleet. The problem is obviously not easy of solution. Nevertheless, it is not regarded as presenting insuperable difficulties, and the naval programme is based almost entirely upon the keeping open of a seaway between Marseilles and the North African coast. Submarines, destroyers, torpedo boats, seaplanes and scouts constitute mainly the first part of the programme, and now follow the 10,000-ton cruisers, which are described as being likely to rival in speed and armament the most rapid vessels of their class in foreign navies. Speed and gun power are what is being aimed at in these new cruisers. Protection is practically non-existent. It is only when the second part of the programme is well advanced that anything will be done with the final instalment, about which nothing is known for the moment. The French Admiralty has certainly settled upon the main lines of the programme, which may be expected to include a number of battleships, but the construction of the latter is not considered to be urgent. The public has been led to believe that for home defence it is better to spend the money required for the construction of a battleship upon the building of a number of smaller craft, and it is only when the fleet of destroyers, submarines and light cruisers is nearly completed that public attention will be diverted to the battleship.

In France, the Admiralty can undertake nothing without the sanction of Parliament, and no Government would spring the construction of battleships upon the country without previously showing their utility. Still, the Conseil Supérieur de la Marine is credited with being entirely in favour of forming squadrons of capital ships, in which it is approved by the majority of naval officers, on the ground that as France has a great colonial empire she must be able to keep open her sea routes with the aid of powerful battleships. To what extent the naval policy will be modified by the change that has taken place recently in France it is impossible to say. Probably, there will be no modification at all, for in questions of national defence the French are little disposed to rely entirely upon the help of foreign countries, and the only factor that may influence the naval policy is a limitation of armaments following upon a settlement of the European crisis, but such limitation could only be effected with difficulty. Its acceptance would depend upon France possessing an advantage in the Mediterranean, sufficient at least to ensure a perfectly safe communication between North Africa and Marseilles. There are many schemes for extending and equipping the Algerian ports, and the remarkable work being carried out in the Caronte to accommodate an enormous amount of shipping in the Etang de Berre is of importance, not only in connection with the construction of the canal from the Rhone to Marseilles, but more especially in providing safe anchorage and landing facilities for a flotilla that could not be accommodated in the spacious new docks being constructed at Marseilles. The Mediterranean between the South of France and North Africa is therefore regarded as an integral part of the Empire. If the seaway is not in French hands, the existence of the Empire may be imperilled. Africa is to supply everything needed by the Mother Country, to the extent that in time of war France would be self-supporting, even to the provision of liquid fuel, which it is hoped to obtain from vegetable oils. Any interruption to the communication between France and Africa would therefore be disastrous for the country's security.

Such communication can obviously only be assured by a fleet capable of fulfilling one single object, and that is the main reason why the French have always refused to accept any restriction upon the construction of submarines, nor will they, under any circumstances, alienate their right to build as many under-water craft and destroyers as may be regarded as necessary for the maintenance of the seaway across the Mediterranean. The question of limiting naval armaments will doubtless come up for discussion in the early future. The French, however, will never go beyond the resolutions of the Washington Conference, and apply the limitation to submarines unless they are assured, by international agreement, the control of the western part of the Mediterranean, but as there are other naval Powers in that inland sea, the possibility of any such arrangement being come to appears very remote. The French, however, have no illusion as to the future. Their naval programme is being carried out almost solely with a view to ensure safe transport between North Africa and France, and in view of the activity being shown by other countries, they are encouraged to push forward their programme as rapidly as possible. The Government is also being urged to revive the series of naval manœuvres, which are, for the moment, neglected. It is true that special attention is given to gunnery practice, to the extent that a high degree of efficiency is said to have been attained, but little has been done in the way of keeping seamanship up to the mark, and although most of the vessels are more or less out of date, it is argued that they are still useful for the carrying out of manœuvres. The Government is asked to make the best use of the fleet as it is for the training of officers and men until such time as the new fleet will need highly efficient hands.

The Treatment of Water Supplies.

It is not so very long ago that it was considered that the only way properly to treat water intended for domestic purposes, the purity of which was not beyond dispute, was to pass it through sand filters. There is no disputing the fact that slow sand filters give exceedingly good results, and in many parts of the world the health of large communities has been safeguarded by them. London—the healthiest large city in the world—is an outstanding example of their efficacy. They have, however, one defect. They are slow, and because they are slow, to obtain large volumes of purified water necessitates the use of large areas of beds. Furthermore, they

become slower in action the longer they are kept in service, and their surfaces have to be scraped at intervals in order to keep the rate of percolation within reasonable limits. It was a natural development to employ storage reservoirs—apart from their usefulness in affording reserves—so that suspended solids might have time to settle, and so that comparatively clear water might be applied to the filter beds, for that materially prolonged the period during which filters could be worked without scraping. It was in the nature of an accident that it was found out that more or less prolonged storage in reservoirs itself had the effect of purifying the water by destroying the germs of disease. The discovery was made by Sir A. C. Houston, the distinguished director of water examination to the Metropolitan Water Board, who has, moreover, been responsible for many useful discoveries in connection with vegetable growths in reservoirs and in other directions. The desire to increase the rate of filtration also led to the introduction of various types of mechanical or pressure filters in connection with which the water is sometimes pretreated with such substances as lime and sulphate of aluminia or other coagulant, and the filtering material in which can be readily cleaned by reversing the direction of flow of the water. High rates of filtration are possible with filters of this class, and some excellent results are obtained with them. Mechanical filters are now, in several instances, being tried in combination with slow sand filters—the Metropolitan Water Board being among those making the experiment. It would appear that the employment of quick-acting, easily cleaned mechanical filters to remove the larger particles in suspension, followed by slow sand filtration, should not only permit of a higher rate of percolation through the sand filters, coupled with a longer "life" of the latter without scraping, but should also produce water of unquestionable purity. The decreased area of slow sand filters required for a given volume of water might be set against the cost of operating the mechanical filters.

Many ways of sterilising water by the addition of chemicals and by other means—such as exposure to the action of ultra-violet rays—have been suggested in the past and practised to some extent. The germ-destroying qualities of chlorine were early realised, but its application on a large scale is of comparatively recent date. Indeed, in the case of the Metropolitan supply, it was the direct result of the war. Desirous of saving as much of the cost of pumping water into the reservoirs as he could and of lessening to the utmost the consumption of coal when it was scarce and dear, Sir Alexander Houston set himself to ascertain whether effects, equally good as regards sterilisation, might not be obtained by treatment with chlorine as with lengthened storage in reservoirs. The results he achieved have been astonishing. Since the commencement of the treatment, some eight years ago, the gross calculated saving has been no less than some £120,000, in consequence of reduced pumping, while at the same time the extreme purity of the water distributed to consumers, for which London is justly famed, has been fully maintained. It is not too much to say that no one man has done more in the way of providing pure water supplies than Sir Alexander, and there is no one who insists more strongly on the necessity of deriving those supplies, whenever it be possible, from absolutely unpolluted sources. The main sources of London's supplies are anything but unpolluted, yet the fact remains that the water as it reaches the consumer is of outstanding purity. Sir Alexander is the last man to countenance the chlorine treatment if he were not perfectly satisfied on that point. With the Thames, apparently no "taste" troubles have been experienced as the result of applying the chlorine treatment, and millions of people have, for some years past now, been using chlorinated water without knowing it, and with no complaints as to taste. With the Lee water there was, at first, some difficulty with "taste" that was variously described as similar to iodoform or to the geranium. Sir Alexander's skill was, however, sufficient to get over even that objectionable attribute of the treatment, and no complaints are, we believe, now being received. The power of chlorine to destroy the bacteria of disease is, if properly applied, complete. The element is, it seems, equally effective whether it be used in the form of a gas or in that of the substance known in commerce as chloride of lime. Both forms are, we understand, being employed in connection with the Metropolitan supplies. It must not, of course, be imagined that chlorine treatment will do away—in the case of London, at any rate—with the necessity for constructing reservoirs, for, owing to the uncertainty of our climate, there will always be times when the flow in the river will not be sufficient to meet requirements. But it does allow of a very considerable reduction in the amount of pumping necessary, and incidentally it enables water which, otherwise, would be entirely unfit for human consumption, to be made wholesome and potable.

The various processes and methods of treatment mentioned above have been specially introduced to remove something from the water which it is undesirable, for one reason or another, that it should contain. The latest development in the treatment of water supplies is of an entirely different character. It has apparently been ascertained that the absence of iodine from the human system is the cause, or, at all events, a contributory factor in the occurrence of goitre. The town of Rochester, N.Y., is in what is known as the goitre district of the Great Lakes, and the idea occurred to its Health Authorities that if sodium iodide were added to the water before it was allowed to enter the mains for distribution to consumers, the latter would, of necessity, receive the iodine compound into their systems, and their liability to contract goitre would be minimised if, indeed, it were not made to disappear. There is no doubt, it seems, that goitre is particularly prevalent in the place, an examination of a school of some two hundred and fifty girls showing that over half of them were more or less affected. The authorities had the courage of their opinions, and they are now adding a total of 700 lb. of sodium iodide per annum to the town's water. The treatment is given twice a year; once in the spring and again in the autumn, and it covers a period of about three weeks in each case. The cost is in the neighbourhood of one half-penny per head. It has not been continued sufficiently long, apparently, to admit of any definite results, saving that no ill effects of any kind have been observed, though large numbers of protests have been received from indignant consumers, who object to being, willy-nilly, medically treated. The Health Officer of the Town, however, is reported to have stated that he sees a visible improvement as compared with a year ago. It is an interesting experiment, and its results will be looked forward to with interest, but it is a moot point whether a water authority is entitled compulsorily to physic all the consumers in the area it controls. We are inclined to sympathise with those, and apparently there are many, who have raised their voices in protest. The matter is not quite on a par with chlorination; for that is practised to render innocuous something which is potentially harmful. As a matter of fact, too, de-chlorination is sometimes resorted to, so that no chlorine, as chlorine, can enter the human system. On the other hand, it is with the avowed object that iodine shall enter the systems of consumers that the anti-goitre treatment has been instituted.

One Hundred Years of British Railways.

No. IX.*

PART II.—THE FIRST HALF CENTURY.

THE LIVERPOOL AND MANCHESTER RAILWAY.

The first means to give better communication, other than by road, between Liverpool and Manchester, was the improvement of the river Mersey, then navigable from Liverpool to Runcorn, so that boats could sail eastwards as far as Warrington. This work was sanctioned in 1694. By the Mersey and Irwell Navigation Act of 1720, the Irwell also was improved so that it was available westwards to Warrington. There was, thus, through water communication between Liverpool and Manchester. The route taken was, however, so circuitous that boats followed a course of from 30 to 40 miles to cover a distance of no more than 20 to 25 miles. Moreover, there was rarely a sufficient depth of water in the summer, whilst in winter the floods prevented navigation. Only at high tide could a boat from Liverpool reach the first lock, situated above Warrington Bridge. Dr. Aikin in "A Description of the Country from Thirty to Forty Miles round Manchester" (1795) said "The want of water in droughts and its too great abundance in floods, are circumstances under which this, as well as most other navigations, has laboured."

Two miles below Warrington the Sankey Brook flows into the Mersey. This brook is formed by three streams running through the St. Helen's coalfield. It was considered that, if it, too, could be made navigable, the supply of coal to Liverpool would be increased and cheapened. The Corporation, therefore, obtained powers in 1755 to canalise Sankey Brook; the work was found to be impracticable owing to the crooked course taken by the streams and by the area concerned being subject to floods. These difficulties were, however, solved by the cutting of a new canal. This work was of special interest inasmuch as it opened the canal era, and when the part played by the town of Liverpool in the evolution of railways is considered the fact that that city initiated canals also should be remembered.

The next step towards improving communication between Liverpool and Manchester was taken at the Manchester end in 1759. The then Duke of Bridgewater obtained powers to construct a canal from his collieries at Worsley to Manchester. The distance was only 7 miles, but the roads were impossible, and the Mersey and Irwell Navigation would not reduce its charge of 3s. 6d. per ton, even though the Duke volunteered to provide his own boats. His canal was opened on July 17th, 1761, and in the following year he secured a Bill to make a canal from a junction with the Worsley Canal at Lingford Bridge, Manchester, to Runcorn. The Duke's fight with the Mersey and Irwell Navigation to obtain these powers was a very bitter one. In Clifford's "A History of Private Bill Legislation" (1885) it was said "Not even the battle of the gauges or any of the great territorial struggles between our most powerful railway companies were more hotly contested than the Duke of Bridgewater's attack in 1761–2 upon the monopoly of the Mersey and Irwell Navigation."

As this is a history of railways it will be appropriate to recall that in 1766 canal communication between the rivers Mersey and the Trent was sanctioned. The canal bore the name of the Grand Trunk, and the fact is mentioned here because (1) this company was the first canal company to obtain powers to make railways, which it did in 1776; (2) because the whole of the property subsequently passed into the possession of the North Staffordshire Railway Company; and (3) because it presents the only case of a railway-owned canal being a source of profit.

The Mersey and Irwell Navigation Company was locally known as the "Old Quay," that being the name of its terminus in Manchester; the Bridgewater Canal was usually called the "Duke's."

It is not clear who first suggested a railway between Liverpool and Manchester, but it is significant that all writers have given William James the credit for the first survey. It was, according to his diaries, as recorded by E. M. S. P. in "The Two James's and the Two Stephensons," made in 1819 and 1820. The same diaries show that, in August, 1802, James, when at Leigh, also discussed a line of railroad "by Ellenbrook Chapel to the Duke's Canal," and that in October of the same year he saw a Mr. Fletcher as to "three lines of railroad he had discovered to the Leeds and Liverpool Canal and the Duke's Canal." E. M. S. P. proceeds to add: "It was at this period that his mind was first impressed with the importance of the function of railroads from Liverpool to Manchester, Bolton, &c. . . . for the quicker transit of cotton and other goods." Moreover, Henry Booth, who, being treasurer of the company and its historian, was in a position to know the facts, said in "An Account of the Liverpool and Manchester Railway (1831)," that the question of a railway was first discussed in 1822, and that "Mr. William James, of London, engineer, having witnessed the powers of the locomotive engine in the neighbourhood of Newcastle, conceived that it might be successfully employed on a railway for commercial purposes. He brought a letter of introduction to Mr. Sandars, a gentleman who, having had practical experience of the insufficiency of the existing modes of conveyance from Liverpool to Manchester, was prepared to give all due consideration to any plan which proposed a remedy for a tried grievance. Mr. Sandars adopted the scheme and became father to the present undertaking."

In an article entitled "William James and the History of Railways," contributed by Mr. R. Seymour Ramsdale to THE ENGINEER of August 14th, 1908, it was stated that it was early in 1821 that James met Sandars and that it was in 1822 that the survey was completed. This statement suggests that in 1819–1820 James made a rough survey on his own initiative, saw Sandars in 1821, and completed the plans in 1822. Certain it is that on October 4th, 1822, James wrote to Sandars: "I came last night to send my aide Robert Stephenson back to his father and to-morrow I shall pay off Hamilton and Evans. I have now only left me Messrs. Padley and Clarke to finish the copy of plans for Parliament which will be done in about a week or ten days." James, the following month—November—was arrested for debt and lodged in King's Bench prison and made a bankrupt. This mishap put a temporary stop to the scheme for a railway between Liverpool and Manchester.

Interest in the question was not, however, allowed to drop. In the spring of 1824 a deputation, consisting of Joseph Sandars, Lister Ellis and Henry Booth, of Liverpool, and John Kennedy, of Manchester, went as a deputation to Darlington and afterwards to the neighbourhood of Newcastle and Sunderland, "where various railways were in operation and where

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both locomotive and fixed engines were employed for the conveyance of coals from the pits to the respective places of shipment." These gentlemen, on their return, made a report, dated May 2nd, 1824, to a committee of merchants, of which John Moss was the chairman, with the result that it was decided to form a company to establish a railway between Liverpool and Manchester. A committee for this purpose was constituted, and of it Charles Lawrence, the then Mayor of Liverpool, was chairman, whilst George Stephenson was engineer.

For reasons already given William James was unable to undertake the duties of engineer, but E. M. S. P. claimed that "he introduced Mr. Stephenson to the notice of the committee as engineer to the Liverpool and Manchester line, firmly believing that on account of the many and great benefits he (James) had conferred upon him (Stephenson) his own interests would be safe and jealously watched over in his absence. Probably William James had no wish himself to undertake the post of resident engineer; this would have limited him to a sphere far too narrow for his vast and enterprising spirit. He was aware that Stephenson knew nothing of surveying, but believed that, in conjunction with himself and the assistance of Mr. Padley, he could proceed with the line as all the difficulties of the work were already conquered; William James intending by this arrangement to act in unison with Stephenson when circumstances would permit his return to Liverpool, and thus devote some portion of his time to carrying out his other important projects, many of them already nearly completed."

Before leaving William James it should be remarked that John Herepath—no mean authority—said in *Herepath's Journal* of April 12th, 1845, when asked to support a testimonial to Thomas Gray—see Article III.—"We are not clear, however, that Mr. Gray can lay claim to the first conception of a railway system; for if we are not very much mistaken that merit is due to Mr. James."

On October 29th, 1824, the prospectus of the company was issued and the Bill for the railway deposited. After being read a first time and second time the Bill reached the committee stage on March 21st, 1825. The proceedings there have formed an oft-told tale. That they were very long may be judged from the fact that they occupied 772 pages of a blue book. The kind of opposition was best summed up by C. B. Vignoles, who made the survey for the construction of the railway, in his presidential address at the Institution of Civil Engineers on January 11th, 1870:—"The anticipated strenuous opposition to the scheme was not long in becoming realised. The three bodies of canal proprietors, each in itself no despicable opponent, forgetting their mutual animosities, and former disagreements, banded against the new rival in formal array, acting in common impulse, organised under most skilful direction, upholding with tenacity their vested interests, claimed as rights, and prepared at all hazards to resist and crush down so intolerable an innovation on established modes of communication and on their cherished privileges and long maintained monopolies." On June 1st, the thirty-eighth day of the proceedings, the clauses were put to the vote and, after various amendments had been made to the first clause, as to making the railway, it was divided upon and found that the voting was 36 ayes and 37 noes. The next clause, as to taking land, was then voted upon and rejected by 19 noes to 13 ayes. The Bill was then withdrawn. It may be of interest to hear that in those days any member could vote on a Bill. This fact explains why, with a committee of a dozen or so, 73 members voted on the first clause.

It has to be confessed, viewing the matter at this distance of time, that the rejection of the Bill was merited. Its purpose was justified, its finance sound, but the engineering details were ill-prepared. Stephenson made a poor witness. He had not mastered the details of the case, and got lost and confused in the questioning of the eminent counsel arrayed against him. Many of those, too, who had to sit in judgment were probably sceptical and, may be, prejudiced, and were undoubtedly influenced by Stephenson's brusqueness and their failure to understand his North Country dialect.

A year later the case was better marshalled. George Rennie had been made engineer, Vignoles had surveyed the line and adopted a route further south, and the Bridgewater opposition had been bought off by the promise to the Marquis of Stafford of 1000 shares in the new line. More capital was required before the Bill could be again submitted, and in the prospectus issued to secure it, the admission was made that in the first Bill there were errors in the sections and levels and "to avoid all chance of similar complaint in future they have engaged the professional services of most eminent engineers, aided by assistants of undoubted talents and activity, whose combined efforts justify the fullest assurance, not only of the correctness of the plans and sections, but that the line will be laid down and arranged with that skill and conformity with the rules of mechanical science which will equally challenge approbation, whether considered as a national undertaking of great utility or as a magnificent specimen of art." The objections to the use of the locomotive were thus dealt with: "It was contended in the first place that this new and peculiar power was incompetent to perform the task assigned to it; in the second place, that it was unsafe; and, lastly, that in its operation it would prove a public nuisance. By the evidence, however, it was proved that it was perfectly competent to perform all that was proposed to be accomplished, and before the evidence was closed the counsel for the opponents of the Bill admitted it was safe. Upon the third point of objection the Committee are confident such improvements will be made in the construction and application of this effective machine as will obviate all objection on the score of nuisance, and as a guarantee of their good faith towards the public they will not require any clause empowering them to use it, or they will submit to such restrictions in the employment of it as Parliament may impose, for the satisfaction and ample protection, both of the proprietors of the line and of the public at large."

On March 6th, 1826, the second Bill went into Committee. The main question there was the ability of the canal companies to carry the trade. Counsel for the canals urged that the railway, as a conveyance, would be neither cheap nor expeditious; that it would be a grievous injury to the landowners on the line and, at the same time, ruinous to the projectors themselves. The Bill was, however, passed on March 16th by 43 votes to 18, and read a third time by 88 votes to 41 on April 6th. In the House of Lords two voters—Lords Derby and Wilton—were against it. The Bill received the Royal Assent on May 5th, 1826, and became 7 Geo. IV., c. 49.

At a meeting on May 30th, 1826, the question of an engineer was considered. Henry Booth said: "The directors naturally turned their attention to Mr. Stephenson of Newcastle, a gentleman thoroughly

acquainted with practical mechanics and possessing more experience in the construction and working of railways than perhaps any other individual." The directors, at the same time, wrote to Messrs. G. and J. Rennie, asking them to undertake a professional superintendence of the undertaking. George Rennie saw the directors and agreed, on condition that he was allowed to appoint his own resident engineer. This proposition was respectfully declined, and Mr. George Stephenson was elected principal engineer to the company. Two of his assistants were C. B. Vignoles and Joseph Locke, both of whom later made their mark as railway engineers of a standing equal to, if not higher than that of their former chief.

Literature.

Road Engineering. One of the Glasgow Text-books of Civil Engineering. By E. L. Leeming, M.Sc., Assoc. M. Inst. C.E. London: Constable and Co., Limited. 1924. Price 18s. net.

Many interesting problems arise from the development of main road traffic and the adoption of new types of resistant road surfacings, and Mr. Leeming, who seems to have specially studied the actions and reactions of vehicles and roads, usefully devotes about a quarter of his book to such matters, his chapters on Curves and on Superelevation being specially noteworthy. This portion of the book may be recommended alike to engineers and to students. Another group of subjects, occupying about two-fifths of the volume, includes a good deal of matter which may be regarded as fairly good text-book material, but as applying only to main road and city street maintenance, for it does not include the data and information necessary for an understanding of road construction generally, even in the British Isles. In this group one may include a part of the chapter on Bituminous and Tarred Roads, the chapters on Concrete Roads and Reinforced Concrete, and those dealing with machinery, sidewalks, the reinstatement of paving, and administration. The author's own discussions of some matters are very short, as, for example, in the case of reinforced concrete, in which it occupies eleven lines.

The space left, about a third of a book of 274 pages, is clearly insufficient for an adequate treatment of all the other matters essential in road construction. The title of the book is, in fact, a misnomer. We may give the author credit for having dealt successfully with the points of contact of the two halves of the transport problem, vehicle design and road design. It is a special study, and quite worth while. But he has not produced a treatise or a text-book on road construction. He does not deal with the road as an earthwork, which may pass through swampy land or sand hills, and over clay, gravel or rock. He does not treat of the planning of roads in relation to the land or of the main principles of design. He devotes only a page to subsoil drainage, less than a page to culverts, and two pages to reinforced concrete retaining walls, dismissing brick retaining walls as no longer interesting. He does not mention stone retaining walls, although he has a chapter on hill roads. Attrition tests are described, but no results are given. One kind of rock is mentioned in the book, but not one species of timber is named. For all its huge mileage, the water-bound macadam road is, apart from surface treatment, dismissed in a page. Brick paving receives five lines. Nine pages are devoted to bitumen, but only twenty-one lines to bituminous macadam. The work must therefore be regarded as a useful contribution to the literature of the engineering work of main roads and cities in Great Britain, rather than as a text-book on road construction.

Traité de Stabilité du Matériel des Chemins de Fer: Influence des Divers Eléments de La Voie. Par Georges Marie, Ingénieur Chef de Division en retraite des Chemins de Fer de Paris à Lyon et à la Méditerranée. Paris: Librairie Béranger, 15, Rue des Saints-Pères. 1924. Price 58f.

The subject-matter of this excellent treatise has been available for many years in a series of memoirs which its author published between 1905 and 1911, as the results of studies begun in 1901, and which he has now rearranged and presented in a single volume. The method of the treatise is to consider the different elements of the rolling stock and the road, as a single study, from the point of view of stability, and to take into consideration the influence of rhythms ("résonances") whenever they affect the results, rhythm being due to synchronism between the effects of rail joint intervals and the natural oscillation of the vehicle on its springs. Rhythms due to horizontal oscillations are also taken into account. The author has analysed the various oscillations and perturbations, separate or combined, which tend to cause discomfort or danger. He has calculated the coefficients of safety from derailment of the various axles at different speeds, and in different parts of the road. The work is throughout mathematical, logical and practical, the applications being to specified conditions of actual practice.

A study of the oscillations due to yielding at rail joints and of the "condition of convergence of oscillation" is followed by a consideration of rolling oscillations and wobbling oscillations ("oscillations de lacet"), and of the conditions when entering and leaving curves. Next comes an investigation of the oscillations due to the rolling stock itself, especially the locomotive, and of the effects of high speeds. The unsprung masses next receive attention, and formulas for the measurement of their effects are given. The author then deals successively with gyroscopic effects; the conditions causing derailment, with Pocket's formula modified and generalised; the meaning of "comfort"; improved oscillations; "a-periodic" suspension; and the application of the formulas to the calculation of the degree of stability of a vehicle, as regards both derailment and capsizing. This matter is fully worked out for a "Pacific" locomotive, and the way in which the application may be made to suit other cases is explained. This result is described as "the goal of our studies since 1901." The calculations of stability should, the author considers, be made as fully as in the case of a ship. Many matters of practical designing are discussed in their relation to stability, and the author has doubtless succeeded in producing a work which will, as he hopes, "facilitate the study of new types of rolling stock and the improvement of existing types, from the point of view of stability and comfort, as well as eventually the examination of the question of an increase in speeds."

There have been several minor mishaps of late on the London, Midland and Scottish system. One occurred at Exchange Station, Liverpool, on the 20th inst., when a passenger train failed to pull up at the required spot clear of two vans standing against the buffer stops. The effects of the collision were only slight, but, because most of the passengers were standing prepared to alight, several were cut or bruised. On Monday last an express from Manchester failed to pull up when entering Euston Station and came into collision with the buffer stops.

New Sewage Works at Tilbury.

As we briefly announced at the time, the new sewage disposal works of the Thurrock, Grays and Tilbury Joint Sewerage Board were formally opened by the Chairman of the Board on March 1st last. The event marked the successful termination of an engineering undertaking, during the carrying out of which difficulties of considerable magnitude and peculiar character were encountered and overcome. To these difficulties, which were entirely due to the nature of the ground through which the necessary sewers had to be run and at the site of the disposal works, we shall refer more particularly later in this article.

Meanwhile it may be explained that the Joint Board was formed in the year 1912 under the Thurrock, Grays and Tilbury Joint Sewerage Order. The district served by the Board comprises the areas of the Grays and of the Tilbury Urban District Councils, and the parishes of Little Thurrock, Stifford and West Thurrock in the Orsett Rural District Council. The Order provided that the main sewer should start from the Royal Hotel at Purfleet and should terminate to the east of, that is to say, lower down the river than, Tilbury Docks. Soon after the formation of the Board Mr. G. Midgley Taylor, of Messrs. John Taylor and Sons, of Westminster, was instructed to report upon the provision of a main intercepting sewer and upon the best method of disposing of the sewage collected by it. Mr. Taylor's report was delivered in April, 1913, and his recommendations were adopted in their entirety and subsequently were approved, after inquiry, by what was then the Local Government Board. An immediate start was determined upon, and, the Board having decided to carry out the work in sections, tenders were invited for the laying of the sewers in West Thurrock leading to an intermediate pumping station, the purpose of which we shall presently explain. A contract with Mr. Edmund Iles to carry out this section for about £22,250 was provisionally entered into. This figure approximately coincided with the engineers' estimate. As a matter of fact, however, the commencement of operations was destined to be delayed for five years or so, for the war intervened and nothing could be done until 1919.

The district through which the main intercepting sewer passes lies on the north bank of the Thames estuary and it contains, in addition to residential property, many important cement works and other factories. The population resident in the area was, as given by the Census of 1911, almost exactly 30,000. At the present time it is estimated that that number has increased to 33,000 or a little over. At the time the report was presented it was calculated that the population would, by the year 1943, have risen to about 66,000 and the capacity of the main outfall sewer was designed on that basis, assuming a water supply of 25 gallons per head per day, or a dry weather flow of 1,650,000 gallons in the twenty-four hours. The Provisional Order contains clauses which enable the Board strictly to limit the quantity of surface water admitted to the sewers of the constituent authorities, and in view of that fact it is anticipated that in time of storm the flow will never increase above the rate of six times the average dry weather flow. As a matter of fact the lower length of the lower outfall sewer is 36in. in diameter and it is laid at a gradient of 1 in 1400, which will enable it to discharge about 10,000,000 gallons per day, or just more than six times the dry weather flow from 66,000 persons at 25 gallons per head.

The furthest point from the disposal site from which sewage is conveyed is about 7 miles. The route taken by it is shown in the map, Fig. 1. It was, unfortunately, not found possible to gravitate the sewage from the whole area, and it was therefore necessary to construct an intermediate pumping station, which is situated at the point indicated on the accompanying sketch plan. It lies in the parish of West Thurrock at about 2 miles east of the Royal Hotel at Purfleet, where, as already mentioned, the sewer starts. The small pumping station contains machinery which is capable of dealing with a maximum of 1,300,000 gallons of sewage per day.

The sewage is lifted by means of three 4in. Stereophagus pumps and there is space in the house for a fourth unit. The pumps are belt driven through a countershaft by two Campbell oil engines of the two-cycle two-cylinder type, each capable of developing a maximum of 66 brake horse-power and 60 brake horse-power working load at 350 revolutions per minute. The total head including friction when all three pumps are working is 72ft.

This pumping station is designed to deal with the sewage of the whole of the parish of West Thurrock, and the intercepting sewer, which is 12in. in diameter, is laid, more or less parallel with the railway line, to the pumping station. From the latter the sewage is delivered through about a mile and a-half of 12in. pumping main into the head of the main gravitation sewer which leads to the purification works. The latter sewer, which is 15in. in diameter to begin with, is increased to 21in., 30in., 33in., and finally to 36in. in diameter. On its route it picks up the whole of the sewage of the Grays Urban District Council and of the Tilbury Urban District Council, as well as a small quantity of sewage coming from Little Thurrock.

Nearly the whole length of this sewer, the invert of which varies in depth from the surface from 8ft. to

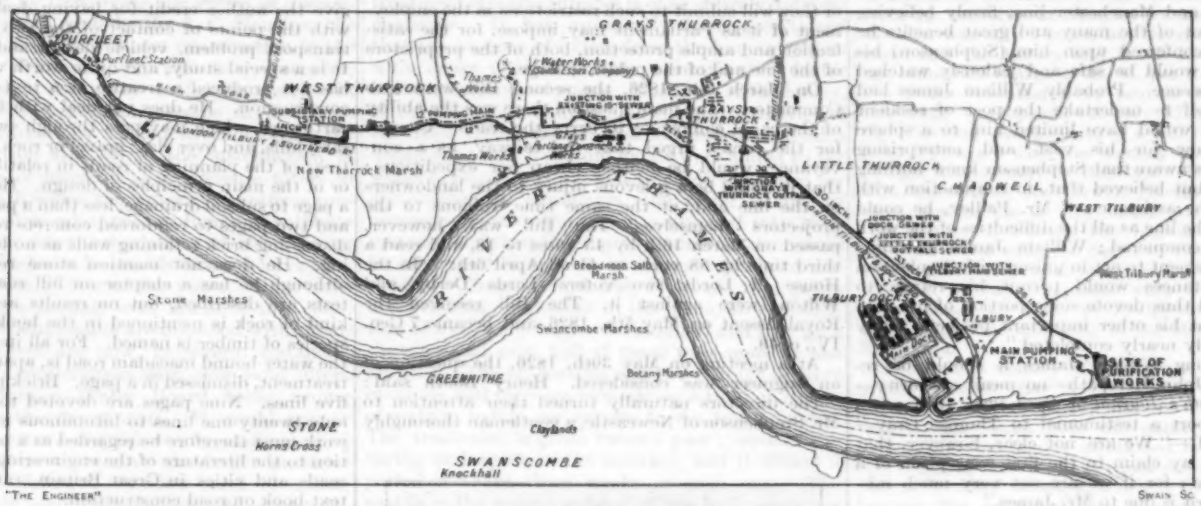

FIG. 1—PLAN SHOWING ROUTES OF SEWERS AND POSITIONS OF SUBSIDIARY PUMPING STATION AND PURIFICATION WORKS

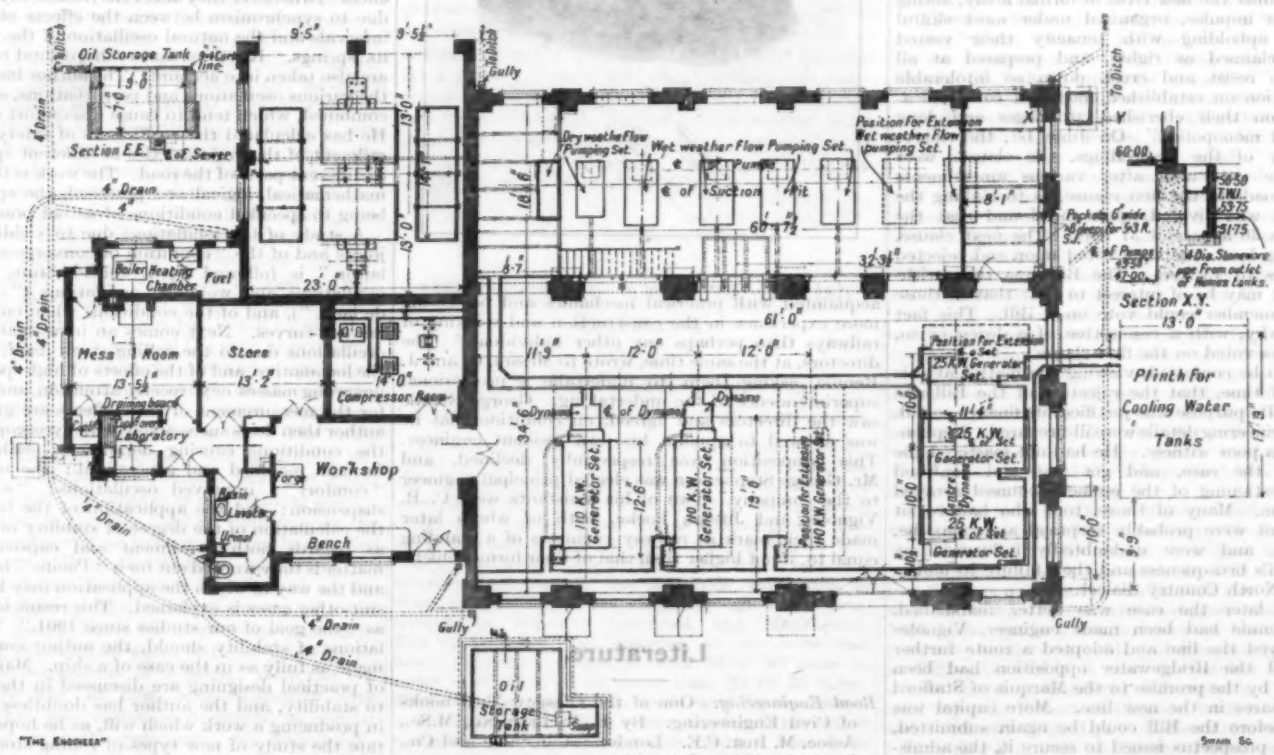

FIG. 2—PLAN OF ENGINE AND PUMP HOUSE

29ft., was constructed through marshes where the subsoil consists of peat and semi-fluid clay, the consistency of which may perhaps be best described by saying that it resembled that of soft newly made cheese. It proved, as has been said, extremely troublesome to work in. Of such a fluid nature was it that when an excavation reached a depth of some 15ft. the bottom of the trench was forced up by the weight of soil on either side, and timber decking had to be provided to withstand the upward pressure. We did not have an opportunity of seeing excavation actually in progress, but we have seen photographs of closely boarded trenches, and the distortion of the timbering was well nigh incredible. The badness of the ground for building purposes is well known in the neighbourhood and a large proportion of the houses in the district show signs of settlement, some of them being very noticeably out of the perpendicular. In spite of all the difficulties, however, the sewer was eventually laid in a sound and water-tight manner, though, as can well be understood, having such soil to deal with did not conduce to speed of construction or to cheapness.

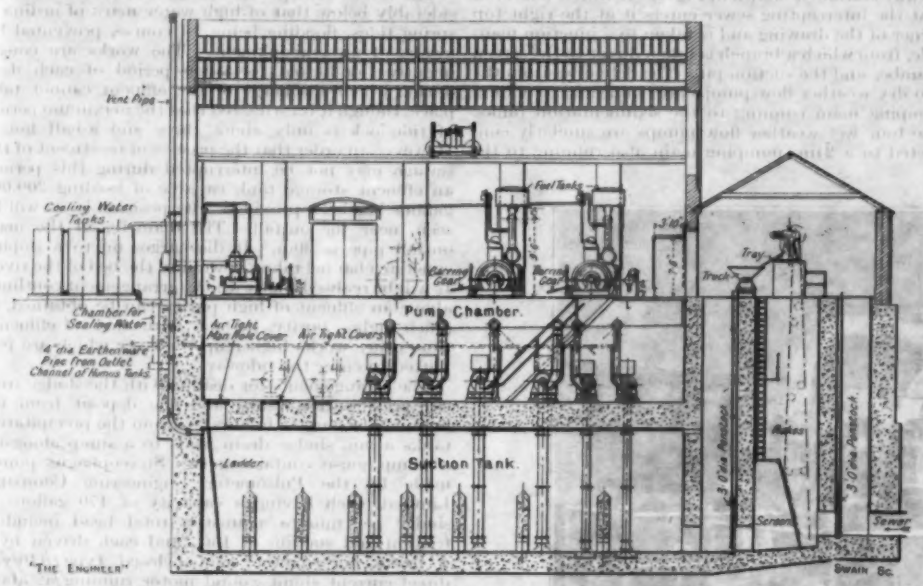

FIG. 3—SECTION THROUGH ENGINE HOUSE, PUMP CHAMBER AND SUCTION TANK

On arrival at the purification works the sewage is first passed through a screen chamber which is furnished with two screens each 6ft. wide and 11ft. 9in. high arranged 32ft. from the bottom of the screens to the engine-house floor. Each screen has its own raking apparatus, which is driven through gearing by a 3 brake horse-power 440-volt electric motor running at a speed of 850 revolutions per minute. The contractors in chief for the pumping machinery, which we are about to describe, were W. H. Allen, Sons and Co., Limited, of Bedford, and the subcontractors for the screens and raking gear were George Waller and Sons, of Stroud, Gloucestershire. The raking apparatus is arranged for discharging the screenings on to a tray at such a level above the engine-house floor as permits of a truck running on a narrow-gauge line to be run under the lip of the tray to receive the solids which are wheeled away to a dumping ground.

The screen chamber is provided, both at the inlet and outlet, with 36in. penstocks, which are operated from the same level as the engine-house floor. The invert of the sewer as it enters the screen chamber is 30.30ft. above datum, which is 50ft. below Ordnance Datum. The bottom of the screen chamber, which is 8ft. wide, is sloped from + 28.95 to + 28.45 in the direction of the suction tank, the level of the floor of which is + 28.33 and which measures 60ft. 7½in. long by 18ft. 6in. wide. The pumping equipment has been purposely made to be very flexible. It consists at present of (*a*) two dry weather flow pumps, each capable of delivering 1,300,000 gallons of screened sewage per twenty-four hours against a total head, when both pumps are running, of 46ft., including friction and suction; and (*b*) four wet weather flow pumps, each capable of delivering 2,285,000 gallons of screened sewage per twenty-four hours against a total head, when all four pumps are running, of 46ft., including friction and suction. Provision is also made for the future addition, should it be found necessary, of two further wet weather flow units of the same type and size. The present equipment is, it will be observed, capable of delivering up to 11,740,000 gallons of sewage per twenty-four hours when all the pumps are working together and varying quantities less than that volume down to 1,300,000 gallons per day. All the six pumps are of Messrs. Allen's "Conqueror" type. Each is coupled direct, through a flexible coupling, to a 440-volt direct-current totally enclosed shunt-wound motor, the brake horse-power of the smaller machine being 25 when running at a speed of 1000 revolutions per minute, and of the larger 45 when running at a speed of 650 revolutions per minute. The suction and discharge inlets of the smaller pumps are 8in. in diameter and the suction inlets are connected by taper pieces to 10in. suction pipes descending into the suction tank. Similarly, the suction and discharge inlets of the larger pumps

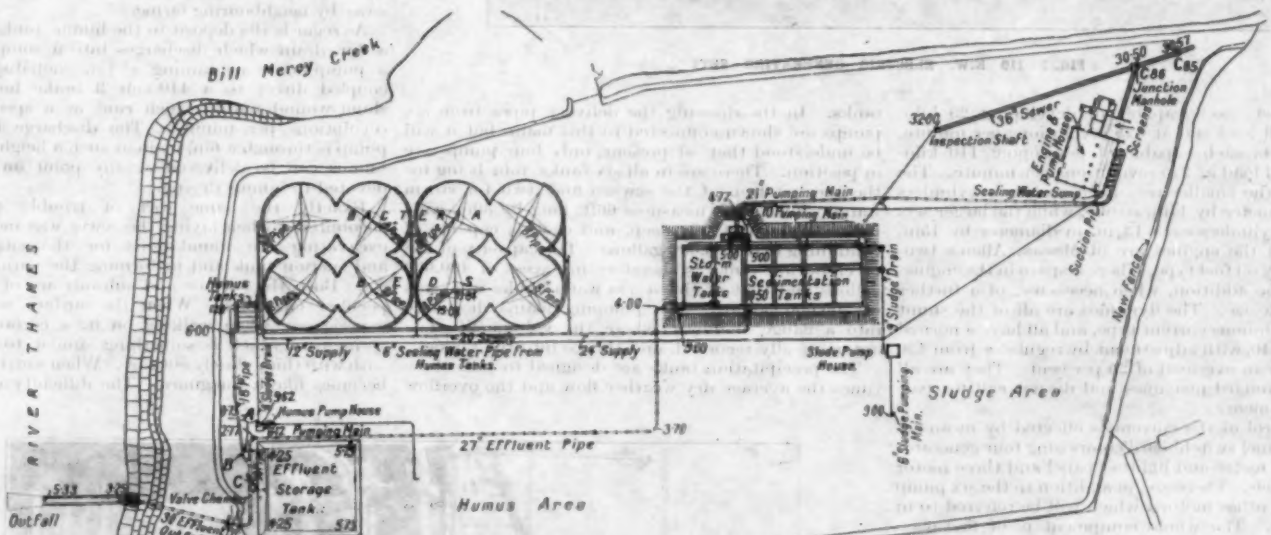

FIG. 4—PLAN OF SEWAGE PURIFICATION WORKS

FIG. 5—STORM WATER AND SEWAGE SEDIMENTATION TANKS

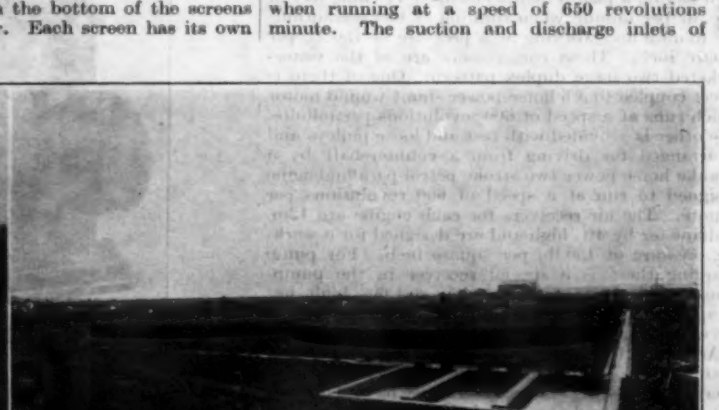

FIG. 6—PERCOLATING FILTERS AND HUMUS TANKS

are 10in. in diameter, and the former are connected by taper pieces to the 14in. suction pipes. The arrangement of the pump-house building and its machinery are shown in the plan and section, Figs. 2 and 3.

Owing to the isolated position of the disposal site the Board decided, on the advice of Mr. Midgley Taylor, that its pumping plant should be self-contained and that the motive power for the pumps should be electricity, the current being obtained from oil engine-driven dynamos. Like the pumping plant, the electrical generating plant has been made exceedingly flexible. At the present time it consists of two

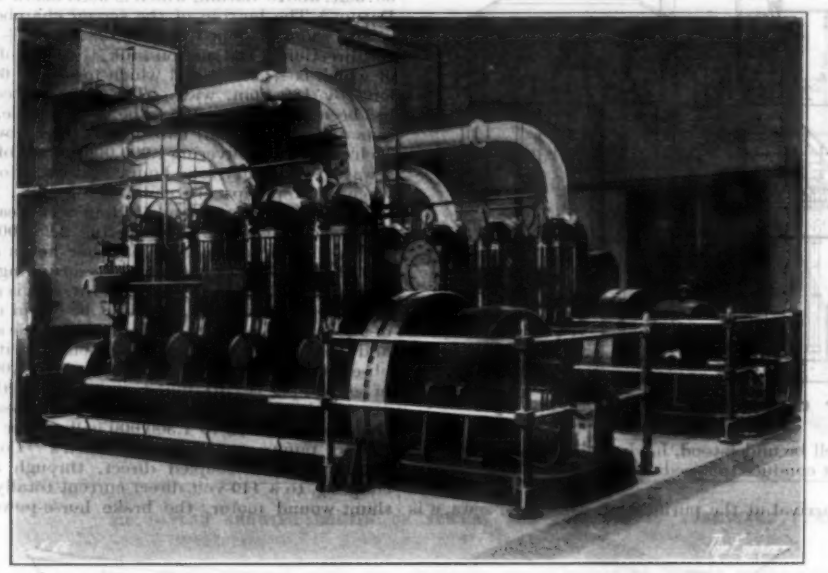

FIG. 7—110 K.W. ELECTRIC GENERATING SETS

combined sets each capable of developing 25 kilowatts at full load and at 375 revolutions per minute, and two sets each capable of developing 110 kilowatts at full load at 275 revolutions per minute. The engines of the smaller sets have each two cylinders 9½in. in diameter by 11in. stroke, while the larger sets have four cylinders each 13¾in. in diameter by 15in. stroke. All the engines are of Messrs. Allen's two-stroke heavy oil fuel type. There is space in the engine-room for the addition, when necessary, of a further unit of each size. The dynamos are all of the shunt wound continuous current type, and all have a normal voltage of 440, with adjustment by regulator from 430 to 450 with an overload of 25 per cent. They are all of them standard machines and do not call for particular comment.

The control of the current is effected by means of a marble-panel switchboard comprising four generator panels, one meter and lighting panel and three motor control panels. There are, in addition to the six pump motors, six other motors, which will be referred to in due course. The whole equipment is of first-class character and is, so we are informed, operating excellently in every way.

For starting the engines and for charging the pumps there are arranged in a room separate from the main engine-room two two-stage Axial type air compressors made by Reavell and Co., Limited, of Ipswich, each having a piston displacement of 11 cubic feet of free air per minute when running at 600 revolutions per minute and working at a pressure of 150 lb. per square inch. These compressors are of the water-jacketed two-stage duplex pattern. One of them is direct coupled to a 5 horse-power shunt-wound motor which runs at a speed of 600 revolutions per minute. The other is provided with fast and loose pulleys and is arranged for driving from a countershaft by a 5 brake horse-power two-stroke petrol-paraffin engine designed to run at a speed of 600 revolutions per minute. The air receivers for each engine are 12in. in diameter by 4ft. high and are designed for a working pressure of 150 lb. per square inch. For pump charging there is a special receiver in the pump-house. It is 1ft. 5in. in diameter and 6in. high, has a capacity of 12 cubic feet of air and is also designed for a working pressure of 150 lb. per square inch.

Arranged to span the engine-room and pump chamber are two double girder overhead hand-operated travelling cranes, the former having a capacity of 5 tons and the latter of 1 ton. For cooling the water for the cylinder jackets of the engines there are twelve galvanised cylindrical tanks, each 4ft. in diameter by 8ft. high, with the necessary circulating pumps, &c. The tanks are placed outside the engine-house, in the position shown in Fig. 2.

Before leaving the pump-house we may say, first of all, that an oil storage tank capable of containing 2000 gallons is arranged below ground level adjacent to the building and covered with cast iron chequer plating. Then there are a workshop containing a forge, a staff messroom, a laboratory, a heating chamber containing a boiler, a store room, a lavatory, &c. The relative positions of these various rooms will be seen in the plan, Fig. 2, and views of various parts of the station are given in Figs. 7 and 8.

The general arrangement of the disposal site, which lies something under a mile eastwards of Tilbury railway station, is shown in Fig. 4. It will be observed that the intercepting sewer enters it at the right top corner of the drawing and is taken to a junction manhole, from which a branch is taken direct to the screen chamber and the suction pit. The deliveries from the two dry weather flow pumps are connected to a 10in. pumping main running to the sedimentation tanks. The four wet weather flow pumps are similarly connected to a 21in. pumping main also running to the tanks. In the drawing the delivery pipes from six pumps are shown connected to this main, but it will be understood that, at present, only four pumps are in position. There are in all six tanks, four being for the precipitation of the sewage and two for storm water. Each tank measures 66ft. long by 30ft. wide by an average of 9ft. deep, and each is capable of containing over 100,000 gallons. The capacity of the precipitation tanks is therefore in excess of 400,000 gallons and that of the storm water tanks in excess of 200,000 gallons. The pumping mains discharge into a gauge chamber, where the volume lifted is automatically recorded, and thence into the tanks.

The precipitation tanks are designed to take three times the average dry weather flow and the overflow from them is taken through a 24in. gravitation main to eight percolating bacteria beds, each about 85ft. in diameter and each furnished with four-armed automatic distributing sprinklers. The total volume of filtering material in the eight beds is some 9000 cubic yards, which works out at about 1 cubic yard for each 100 gallons of dry weather flow sewage.

The effluent from these filters passes to humus tanks, the discharge from which can flow direct into the river. The overflow from the storm water tanks can also flow direct into the river through a 27in. effluent pipe, and after the storm has ceased the top water in them is led back through a 9in. draw off pipe into a 36in. sewer, which, as will be observed, is taken to the junction manhole into which the main intercepting sewer discharges.

The level of the ground of the disposal site is considerably below that of high water mark of ordinary spring tides, flooding being, of course, prevented by means of an embankment. The works are consequently tide-locked for some period of each day, during which, discharge of the effluent cannot take place, though it is estimated that the maximum period of tide-lock is only about three and a-half hours. However, in order that the process of treatment of the sewage may not be interrupted during this period, an effluent storage tank capable of holding 200,000 gallons has been provided. Its position is, as will be seen, near the outfall. The diameter of the main outfall pipe is 30in. It discharges on to a sloping concrete channel taken down into the bed of the river. It will be realised that with the arrangements outlined above an effluent of high purity can be obtained, of much higher purity, in fact, than that of effluents from other works higher up the river which are permitted to enter the tideway.

The arrangements for dealing with the sludge from the precipitation tanks and the deposit from the humus tanks are as follows:—From the precipitation tanks a 9in. sludge drain leads to a sump alongside a pump-house containing two Stereophagus pumps made by the Pulsometer Engineering Company, Limited, each having a capacity of 170 gallons of sludge per minute against a total head including friction and suction of 15ft. and each driven by a 4 brake horse-power semi-enclosed type 440-volt direct-current shunt-wound motor running at about 1200 revolutions per minute. These pumps discharge into a 6in. sludge pumping main, the delivery from which is at such a height that the sludge can be deposited at any point on the area of ground set aside for sludge drying. Sludge drying beds with a layer of ashes and agricultural underdrains are provided, and when the sludge is sufficiently dried it is taken away by neighbouring farmers.

As regards the deposit in the humus tanks, there is a 6in. drain which discharges into a sump beneath a pump-house containing a 4in. centrifugal pump coupled direct to a 440-volt 3 brake horse-power shunt-wound motor which runs at a speed of 750 revolutions per minute. The discharge from this pump is through a 6in. main at such a height that the humus can be delivered at any point on the area devoted to humus drying.

Exactly the same sort of trouble that was encountered when laying the sewer was met with in excavating the foundations for the engine-house and suction tank and in forming the various tanks, &c. Both the surface and subsoils are of the most peculiar character. When the surface is dry one experiences, when walking on it, a certain curious springiness which is something similar to that met with with thick closely cut turf. When wet, the ground becomes like a quagmire. The difficulty of dealing with such ground, when the cost of piling would be prohibitive, can be imagined. But difficulties are made to be overcome, and it is very rarely indeed that an engineer has to admit that he is beaten. The engine-house buildings are founded on piles, but the suction tank was founded on the clay and both are now sound constructions which did not, when we had the opportunity of examining them, exhibit any signs of cracking. That condition of affairs was not, however, arrived at without a considerable amount of trouble and worry. The tanks were in the first instance built of mass concrete with a reinforced

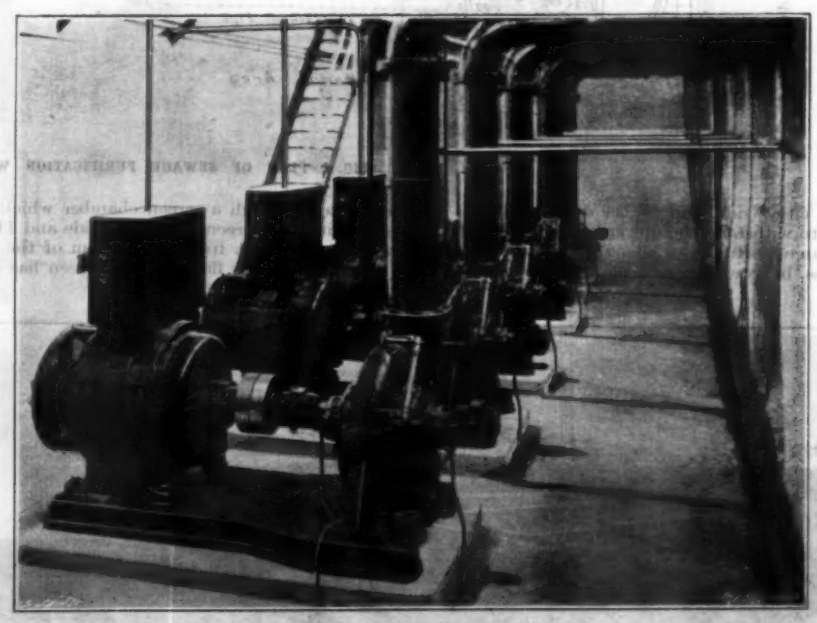

FIG. 8—VIEW ALONG PUMP CHAMBER

pad under the walls, and were then left to themselves for a while. As was anticipated, cracks developed, but when they had opened to their fullest extent and movement had ceased they were carefully filled up and watched. Not until all sign of cracking had disappeared was the brick lining put in, and since it was in position no further trouble has, we understand, been experienced. The only other part of the work in which piling was employed was the outfall. The contractors for the sewer were Messrs. F. E. Binns and Co., of Croydon, and Messrs. Muirhead, MacDonald, Wilson and Co., of Parliament-street, and for the building and purification works Messrs. F. E. Binns and Co. Both are to be congratulated for the way in which their work has been carried out.

We have to acknowledge our indebtedness to Mr. Midgley Taylor for the information from which the foregoing account has been prepared, and for the photographs and drawings from which our illustrations have been reproduced.

Australian Engineering Notes.

A proposal to construct two new automatic telephone exchanges in suburbs of Melbourne, one at Elsternwick and the other at Northcote, estimated to cost £167,875 and £101,723 respectively, has been submitted to the Federal Public Works Committee.

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The works of Messrs. Mephan Ferguson, at Perth, Western Australia, have started on a large State Government pipe contract, after being idle for twenty years.

* * * * * *

Referring to the announcement that it was proposed by the English firm of Guest, Keen and Nettlefold to establish a screw-making factory in Australia, Mr. J. K. Merritt, whose firm is the Australian agent for Nettlefolds, has explained that the decision had been arrived at by the manager of the English company during a visit to Australia in January. A site for the factory had, he said, been purchased at Sunshine, near Melbourne, and an adequate supply of electric power would be available from the State Electricity Commission's works at Yallourn. It was considered that an excellent product for the Australian market could be manufactured in Australia.

* * * * * *

It is expected that an early commencement will be made by the Hoskins Iron and Steel Company, Limited, with the establishment of iron and steel works at Port Kembla (N.S.W.). The estimated cost of the works is £2,000,000. The directors of the company have inspected the site of the works to determine the position of the blast-furnaces. Ore will be transported from the west coast of Tasmania, where extensive iron leases are held by the company. It is the intention of the company as far as possible to manufacture the machinery for the new works in Australia from Australian material. The New South Wales Premier (Sir George Fuller) has promised that money will be made available to commence the construction of the railway from Moss Vale to Unanderra, which the company requires to carry the necessary plant and machinery to the works.

* * * * * *

It is reported from Melbourne that a large extension to the works of the Commonwealth Steel Products Company, Limited, at Port Waratah, near Newcastle (N.S.W.), will shortly be undertaken. The manager of the works is said to have stated that within two months the company would probably be associated with one of the largest engineering firms in England. Under the proposal the Australian company hopes to double its present production, as its activities will be centred in the manufacture of railway locomotives, wheels, tires and axles.

* * * * * *

The assistance of English capital is to be sought for the establishment of an iron and steel industry at Burnie and a cement works at Beaconsfield, in Tasmania. A company, known as the Tasmanian Development Company Pty., Limited, is being formed to conduct preliminary operations, and £750,000, which it is stated has been guaranteed, will be secured in England. It is anticipated that the manufacture of cement at Beaconsfield will be commenced towards the end of the year.

* * * * * *

The Victorian Labour Ministry has decided that Victoria shall be represented at a conference to be held shortly between representatives of the Commonwealth, Victorian, New South Wales and South Australian Ministries with regard to the proposal for the enlargement of the Hume Reservoir. The conference is to decide whether the expenditure of an additional £1,000,000, which would be necessitated by the enlargement of the foundations, should be incurred. A conference of engineers last February recommended the enlargement of the reservoir, which is situated on the Murray River near Albury.

* * * * * *

Huddart Parker, Limited, of Melbourne, has placed an order with the Blyth Shipbuilding Company, Limited, of Blyth (England), for the construction of a new cargo steamer to be used in the Australian coastal trade. The steamer will have three masts fitted with double derricks, and five holds of as nearly similar capacity as possible, and will be of a total deadweight of 6500 tons. The engines are to be made by the North-Eastern Marine Engineering Company. Burns, Philp and Co., Limited, have placed an order with Barclay, Curle and Co., Limited, of Whiteinch, Glasgow, for an up-to-date motor ship for the islands' trade. With a deadweight capacity of 4600 tons, the new vessel will have accommodation for 100 passengers and all the latest appliances for working cargo will be fitted. Her dimensions will be:—Length, 355ft.; beam, 49ft.; and depth, 26ft. The Diesel engines will be of the Burmeister and Wain type supplied by Messrs. Kincaid and Co., of Glasgow.

Following the disastrous fire aboard the steamer City of Singapore at Port Adelaide recently, in which damage amounting to £250,000 was done, in addition to the loss of life, the Victorian port authorities have framed a number of regulations providing for the handling of cargoes of oil and mineral spirits in order to guard against the possibility of a similar outbreak aboard vessels in Victorian ports. These additions to the port rules provide that mineral spirit shall not be shipped or unshipped except at a wharf or anchorage specially set apart for the purpose by the harbour master or wharf manager. Before the cargoes are shipped or discharged twenty-four hours' notice must be given to the authorities by the ship's master. Facilities must also be provided for the authorities to inspect and examine the cargoes, and also all appliances used for the loading or discharging of mineral spirits, to ensure that the regulations have been carried out. The foregoing regulations have been approved by the State Executive Council.

ACCIDENTS IN AMERICAN COAL MINES.

Accidents at coal mines in the United States during June, 1924, resulted in the death of 161 men, according to reports made by State mine inspectors to the Interior Department through the Bureau of Mines. The output of coal during the month was 38,151,000 tons, the fatality rate being therefore 4.22 deaths per million tons of coal mined, as compared with 3.73 for June last year and an average fatality rate of 4.22 for the month of June during the ten-year period 1914–1923. For anthracite mines alone the number of fatalities in June, 1924, was 53, the fatality rate being 6.88 per million tons, as compared with 6.00 for the same month last year and 7.06 for June during the ten-year period. For bituminous mines alone the June rate for 1924 was 3.55 per million tons, as against 3.30 for June last year and 3.68 average for June during the ten years.

Records of the Bureau covering the first six months of 1924 show that 1302 men lost their lives in accidents at coal mines during that period. Of that number, 1049 men were killed at bituminous mines and 253 at anthracite mines. The 1302 fatalities indicate a death-rate of 4.76 per million tons, which may be compared with 3.91 for the first six months of 1923. For bituminous mines alone the 1924 rate for six months was 4.61, as compared with 3.59 for the same period of 1923. For anthracite mines alone the rate for the first half of 1924 was 5.51 per million tons, as compared with 5.61 for 1923.

On June 6th, 1924, an explosion of gas at the Loomis Mine, Wilkes-Barre, Pa., resulted in the death of 14 men. This accident brought the number of "major" disasters in 1924 to 6 with a total loss of 398 lives. In 1923, during the first six months, there were 6 similar disasters with a total loss of 155 lives. These figures indicate that the fatality rate based upon the number of men killed in major disasters during the first half of 1924 was 1.46 per million tons; during the first six months of 1923 the corresponding rate was 0.48.

A comparison of the causes of accidents in the first half of 1924 with those for the first half of 1923 shows that explosions of gas or coal dust continue to be the only class of accidents with increased fatality rates. Decreased fatality rates prevailed in accidents from falls of roof and coal, haulage accidents, and accidents due to the use of explosives and electricity.

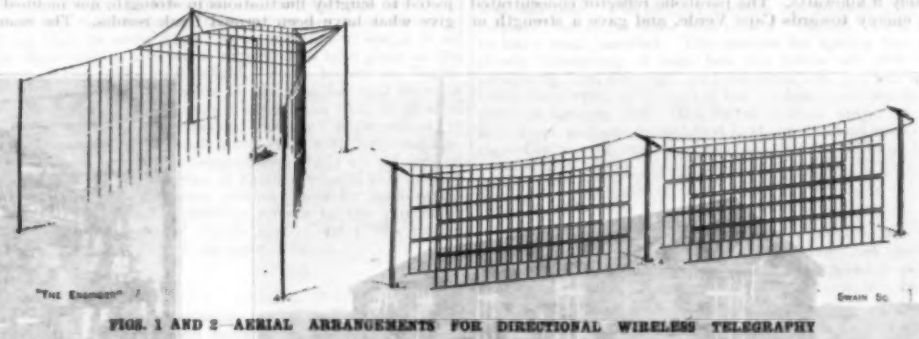
Reports covering the Alaskan coal mining industry for the first five months of 1924 disclose that there were no fatal accidents during the period, although 4 men were injured. The total production of coal in the territory during the five-month period was 40,971 tons. The total number of man shifts was 16,599, indicating an average production of 2.47 tons of coal per man per day. The number of men employed in the Alaskan coal industry ranged from 161 in January to 118 in March.

The amplification of received wireless signals by regeneration in valve circuits is well known. One method of regeneration is the feeding back of alternating-current power by means of inductively coupled coils in the two circuits, from the plate circuit to the tuned circuit connected to the grid of the valve. By means of simple alternating-current theory an equation has been derived from which the amplification produced by inductive feedback may be calculated. This equation shows that regeneration can be considered as producing a reduction in the resistance of the tuned circuit, and so increasing the current. The equation derived was completely verified by experiment. The experiments are described in the Bureau of Standards Scientific Paper No. 487, entitled, "A Quantitative Study of Regeneration by Inductive Feedback," by C. B. Jollife and Miss J. A. Rodman, and a copy of the paper may be obtained from the Superintendent of Documents, Government Printing Office, Washington.

Short Wave Directional Wireless.

In The Engineer of July 4th we published some brief notes of Mr. Marconi's paper on "Results Obtained Over Very Long Distances by Short-wave Directional Wireless Telegraphy, more generally referred to as the Beam System." The paper has now been published in the Society's *Journal*, from which the following additional notes are taken, and through the courtesy of the Marconi Company we are in a position to reproduce the photographs and drawings which were exhibited at the meeting. As previously explained, the reflectors now used for this system are not composed of solid sheets of metal, such as those employed in Mr. Marconi's early tests in 1896, but of a comparatively small number of wires placed parallel to the antenna and spaced around it on a parabolic curve of which the transmitting or receiving antenna constitutes the focal line—as shown in Fig. 1—as it was soon ascertained that this was a much more practical arrangement, and that, moreover, much better results could be achieved.

Since 1916 various patents have been taken out by Mr. Marconi and Mr. C. S. Franklin, and in the latest of these Mr. Franklin describes an arrangement in which the antennæ and reflector wires are arranged so as to constitute grids parallel to each other—as shown in Fig. 2—the aerials or antennæ being energised simultaneously from the transmitter at a number of feeding points through a special feeding system, so as to ensure that the phase of the oscillations in all the wires is the same. It has been



FIGS. 1 AND 2—AERIAL ARRANGEMENTS FOR DIRECTIONAL WIRELESS TELEGRAPHY

proved by calculations and confirmed by experiments that the directional effect of such an arrangement is a function of its dimensions relative to the wave length employed.

During Mr. Marconi's tests in 1916 he used a coupled spark transmitter and the receiver was a crystal receiver. The reflectors employed were made of a number of wires tuned to the wave used, and arranged on a cylindrical parabolic curve, with the aerial in the focal line. Reflectors with apertures up to 3½ wave lengths were tested, and the measured polar curves agreed very well indeed with the calculated values. The Italian experiments showed that good directional working could always be obtained with reflectors properly proportioned in respect to the wave length employed, and with the apparatus then available the range obtained was 6 miles.

The tests were continued in Wales at Carnarvon during 1917, and through the introduction of further improvements, with a wave length of 3 m., a range of over 20 miles was readily obtained when using a reflector at the transmitting end only.

In 1919 further experiments were commenced in which Mr. Franklin succeeded in using electron tubes or valves for the generation of very short waves, the object then being to evolve a directional radio-telephonic system. During further tests and by utilising a 15 m. wave, clear and strong speech was received in Kingston Harbour, at a distance of 78 miles from Carnarvon.

At a later date these tests were repeated over a land range of 97 miles between Hendon and Birmingham. The power supplied to the valves was approximately 700 watts, and the speech received was strong and of good quality. The great value of the reflectors was demonstrated by average measurements made, which showed that the value of the energy received when both reflectors were used was 200 times that of the energy that could be received without reflectors.

In April, May and June of last year a series of long-distance tests were carried out under Mr. Marconi's direction between a small experimental transmitting station at Poldhu in Cornwall and a receiver installed on the steam yacht Elettra.

Mr. C. S. Franklin was responsible for most of the design and operation of the transmitting arrangements at Poldhu, and Mr. G. A. Mathieu was in charge of the receiving apparatus on the yacht, Mr. Marconi also was present during the whole of these tests. Mr. Mathieu was able to make some valuable calculations based on the observed results, especially in regard to the absorption or attenuation of the waves brought about by sunlight.

The principal objectives of these tests were:—

(1) To ascertain the reliability of signals transmitted on approximately a 100 m. wave over considerable distances, with or without the use of a transmitting reflector.

(2) To investigate the conditions which affect the propagation of short waves, and to ascertain the maximum reliable ranges obtainable by day and by night in respect of the power and wave length employed at the sending station.

(3) To investigate and determine the angle or spread of the beam of radiation when employing a transmitting reflector, especially with regard to the possibility of establishing long-distance directional wireless services.

During the tests carried out on the "Elettra," no receiving reflector could be employed, and the strength of the received signals and the ranges covered must have been considerably less than could have been obtained had it been possible to use a fixed receiving station equipped with a suitable reflector.

The tests carried out between Poldhu and the Elettra proved by the definite results obtained that the general conclusions concerning short waves must be erroneous, at least in so far as they may concern waves of about 100 m. long, for it was observed :—

(1) That the day ranges proved to be reliable and not inconsiderable.

(2) That the night ranges were much greater than anyone had anticipated, and no doubt very considerably exceeded the maximum distance the Elettra was able to proceed.

(3) That intervening land and large portions of continents do not present any serious obstacle to the propagation of these waves.

In carrying out these tests it was discovered that it is by no means correct in dealing with these waves to refer to distances covered during daylight as day ranges.

Perhaps one of the most remarkable scientific results of the experimental work carried out on the yacht was to ascertain quite definitively that the coefficient of the well-known Austin formula for the propagation of the waves was defective when applied to short-wave phenomena.

During night-time, even when receiving at St. Vincent, which is situated at 2330 nautical miles from Poldhu, and well within the Tropics, the strength of received signals was so great that absolutely none of the *x*'s or atmospherics were able to interfere in any way with the reception of signals or messages from Poldhu.

During the tests to the Elettra on a 97 m. wave length, the Poldhu transmitter consisted of eight glass valves—standard M.T. 2—worked in parallel, the input to the valves being 12 kilowatts. The radiation from the aerial was approximately 9 kilowatts. The parabolic reflector concentrated the energy towards Cape Verde, and gave a strength of from Poldhu by day up to 1250 nautical miles when that station was using 12 kilowatts of energy.

On May 21st the yacht sailed for St. Vincent, Cape Verde Islands, and although at St. Vincent the anchorage was at a position partly screened by mountains, daylight reception was still possible for a few hours after sunrise, and for some time before sunset.

The night signals continued to arrive from Poldhu at all times with apparently unabated strength, notwithstanding that the distance had increased to about double what it was at Madeira—that is, to 2230 nautical miles. At St. Vincent, as at Madeira, the Poldhu signals could always be received with the heterodyne or low-frequency amplifier switched off. Mr. Mathieu estimated the strength of the night signals at St. Vincent from 400 to 500 microvolts per metre in the aerial, and with such a strength on the wave length employed, no trouble was ever experienced in consequence of atmospherics or *x*'s. In fact, for greater convenience, all messages from Poldhu were read with the aerial out of tune or disconnected from the receiver.

At St. Vincent the signals received from the Post Office at Leafield were weak and often unreadable. Mr. Marconi therefore gave instructions that all wireless messages addressed to him should be transmitted by the short-wave experimental station at Poldhu. No difficulty was ever experienced in the accurate reception of these messages.

The night signals received at St. Vincent, even when Poldhu was using only 1 kilowatt, was much stronger than those received from Carnarvon or than those which could be received at either St. Vincent or Madeira from any of the other European or American high-power stations. The signals by night or by day did not appear to be subjected to lengthy fluctuations in strength, nor inclined to give what have been termed freak results. The results miles, and it was confirmed that the signals' intensity is dependent on the mean altitude of the sun at all times. As a consequence of this, the day limit of the signals on the Cedric was greater than what was observed during the cruise of the Elettra, because the average height of the sun was much less at that time of the year on the particular track of the Cedric, compared to what it was on the far more southernly track followed by the Elettra during the months of May and June.

Signals of great intensity were received at Long Island, New York, during the hours when darkness extended over the whole distance separating the stations, and of less intensity when the sun was above the horizon at either end, the intensity of the signals varying inversely in proportion to the mean altitude of the sun when above the horizon.

According to the measurements carried out by Mr. H. H. Beverage, research engineer of the Radio Corporation of America, the average strength of the signals at New York was 90 microvolts per metre. A few days prior to the commencement of these tests between Poldhu and the Cedric, the chief engineers of the Amalgamated Wireless (Australasia), Limited, of the Marconi Wireless Telegraph Company of Canada, Limited, and of the Radio Corporation of America, had been requested by telegraph to attempt to receive the transmissions radiated from Poldhu in their respective countries.

Mr. Ernest T. Fisk, the managing director of the Amalgamated Wireless (Australasia), Limited, reported by cable that he could receive the Poldhu transmissions at his house in Sydney every day perfectly well from 5 to 9 p.m. (Greenwich), and also that he had received them between 6.30 and 8.30 a.m. He also stated that most of the time the signals were clear, steady and strong on an improvised receiver consisting of a two-stage high-frequency

FIG. 3—THE POLDHU EXPERIMENTAL STATION

FIG. 4—INTERIOR OF THE POLDHU EXPERIMENTAL STATION

field in that direction which would have required a radiation of approximately 120 kilowatts from the aerial without a reflector. For the purpose of the experiment, a special receiver with independent aerial was installed and added to the wireless gear of the Elettra. The receiving aerial was a vertical wire, the top of which was at a height of 20 m. above sea level. The receiver consisted of an aerial circuit, a closed condenser intermediate circuit, a frequency changer circuit, two high-frequency tuned amplifications and an autoheterodyne detecting valve, to which could be added two stages of low-frequency amplification.

After carrying out a few preliminary tests in Falmouth Harbour on April 11th, the Elettra sailed for Cape Finisterre, Spain. A first series of tests was carried out without the transmitting reflector. After rounding Cape Finisterre, it was anticipated that the intervening land would have cut off signals during daytime, and also would have considerably weakened them during the night, but these expectations were not verified.

Signals during the day weakened according to the distance and the altitude of the sun, but were received right up to Seville—780 miles from Poldhu—although practically the whole of Spain, consisting of over 300 miles of high and mountainous land, intervened between the sending and receiving stations.

The night signals were always strong and appeared almost as powerful as those received when the yacht was at her anchorage in Falmouth Harbour at only 12 miles from Poldhu. It should be stated that the yacht, when at Seville, was moored in the Guadalquivir River, in a situation particularly unfavourable for the reception of signals, as the adjacent banks of the river were high and surrounded by trees and buildings.

At Gibraltar—820 miles—notwithstanding the greater distance, a better strength of signals was noticed during the hours of daylight, probably in consequence of the fact that the yacht was anchored in a more open space, and therefore in a more favourable position.

Similar results were also obtained at Tangiers—840 miles—and at Casablanca—970 miles. The night signals were always, and in all places throughout the whole of the cruise, extraordinarily strong and capable of being received at all times without using an amplifier, with the aerial out of tune or disconnected, or without using the heterodyne.

At Casablanca Mr. Marconi telegraphed instructions to hoist the reflector aerials at Poldhu.

The Elettra then proceeded to Madeira, but at Funchal was obliged to anchor in a very unfavourable position for the reception of wireless signals from England, being at the far end of the island and immediately under the mountains of Madeira, some of which rise to heights of over 6000ft.

On May 17th tests were recommenced between Poldhu and the Elettra, but although the night signals were, as always, extremely strong, it was considered desirable to carry out daylight tests in positions not so completely screened by the immediate vicinity of mountains.

Thus it was ascertained that signals could be received obtained could always be repeated over the same distances under similar conditions in respect to the sun's altitude.

The results of the tests were sufficient to convince Mr. Marconi that it would be possible to carry out reliable commercial services for a large portion of hours out of the twenty-four over distances of at least 2300 nautical miles by utilising only about 1 kilowatt of energy at the transmitting stations, and that the practical range of the system, when using 12 kilowatts, had not even been approached.

These results were obviously so encouraging that it was decided to give the new system very careful study and consideration. The station at Poldhu was somewhat improved, and the energy employed was increased to about 20 kilowatts.

Since February of this year a further series of tests have been carried out over ranges which included the greatest

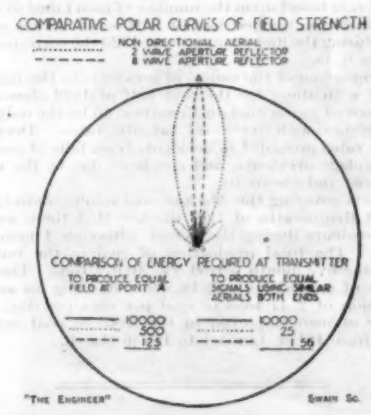


FIG. 5—POLAR CURVES OF FIELD STRENGTH

possible distances separating any two places on earth. A special short-wave receiver was installed on the ss. Cedric, and reception tests were carried out with Poldhu by Mr. Mathieu during a journey of this vessel to New York and back. No reflectors of any kind were employed at either end. For the tests to the Cedric the wave length was 92 m. and the transmitter comprised two oil-cooled valves of special design controlled by an independent drive circuit to ensure steadiness of wave length. The power supplied to the main valves was 21 kilowatts, giving a radiation of approximately 17 kilowatts.

These experiments were conducted with the object of supplementing the information on the general behaviour of short waves over long distances.

The results showed that on the Cedric signals could be received during daytime up to a distance of 1400 nautical

tuned plate and grid with one rectification. He added that he had read every word that was sent, and that the signals were better than those he had yet received from the high-power station at Carnarvon.

These experiments with Australia were continued during the month of May, consistently good results being obtained at two receiving stations situated in the vicinity of Sydney. In Canada, at Montreal, reception was found to be possible for sixteen hours out of the twenty-four.

These results were so encouraging that Mr. Marconi was tempted to try a wireless telephony test to Australia. With rather experimental arrangements at Poldhu, intelligible speech was transmitted for the first time in history from England to Sydney on Friday, May 30th of this year. For the telephone test to Australia, oil-cooled valves were employed. The wave length was 92 m. and an independent drive was employed for controlling the main valves. The total power supplied to the valves was approximately 28 kilowatts, divided up as follows :—Eighteen to the main valves, 8 to the modulating valves and 2 to the drive valves. No reflector was employed.

A continuous development of the short-wave transmitter has been taking place at Poldhu. To utilise considerable power, demanded the study and development of circuits for paralleling valves satisfactorily, and also the design of special valves. To maintain the wave length steady has necessitated the application and development of an independent drive. These problems have been solved satisfactorily, and the production of commercial transmitters dealing with powers up to about 50 kilowatts now presents no difficulties. Figs. 3 and 4 show the exterior and interior of the small experimental station at Poldhu.

It was gratifying to all concerned that the experiment succeeded the very first time it was tried, Mr. C. S. Franklin being in charge of the transmitting apparatus at Poldhu and Mr. Ernest T. Fisk of the receivers at Sydney.

Fig. 5 shows comparative polar diagrams of the field in all directions from three different transmitters. The circle is a polar curve of a plain non-directional aerial. The short dot curve shows the polar curve of a two wave length aperture reflector. The long dot curve shows the polar curve of an eight-wave aperture reflector, such as Mr. Marconi proposes to use for practical purposes. Mr. Franklin has formulated some general laws regarding these aerials, which may be stated as follows :—

(1) The ratio of the loss by radiation to the loss by ohmic resistance, and therefore the efficiency, remains constant for all sizes of the aerial working at the same frequency. This efficiency figure is very high, and can easily be of the order of 80 per cent.

(2) The natural decrement of the aerial is very high, and remains constant whatever the extension, as the ratio of the inductance to the resistance of the aerial remains the same.

(3) The greatest magnification for a given area, and therefore for a given cost, is obtained by having equal areas at the transmitter and receiver. Thus, an aerial

of 20 square wave lengths at transmitter and receiver gives a magnification of 200, but if divided into two aerials at the transmitter and receiver, each of 10 square wave lengths, gives a magnification of 10,000.

(4) For a given area of aerial at the transmitter and receiver, the magnification goes up as the fourth power of the wave frequency used. Thus, assuming aerials 1 kilom. wide and 100 m. high at the transmitter and receiver, these would each be 10 square wave lengths for a 100 m. wave and would give a combined magnification of 10,000. For half this wave length (50 m.) each aerial would be 40 square wave lengths, and would give a combined magnification of 160,000.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Iron Trade and the Building Strike.

THE best feature of the iron trade this week is the end of the building strike. The termination of this national interruption of trade has been received on all hands in this district with unalloyed satisfaction. For some time past the South Staffordshire iron trade has been in a most unsatisfactory condition, and many of the Black Country ironworks have been unable to find profitable employment. Well laid out, finely-equipped plants which have never before slowed down through lack of orders, have been running but intermittently, while, in spite of the fact that the three furnaces at Spring Vale, Bilston, which were temporarily out of action, are now producing again, only 4 out of the 30 blast-furnaces in the Black Country are blowing. The depression has been so protracted that the situation is now considered to be more critical than at any time within the memory of the oldest members of the South Staffordshire iron trade. Building materials form quite a considerable item in the output of some of the Staffordshire iron mills, and while the strike has been in progress orders for light constructional material for home use have distinctly suffered, making the plight of the already badly hit producer worse than it already was. Now, however, some few orders may be expected from this quarter, and iron masters, therefore, expressed their gratification at the end of the builders' strike.

Finished Iron.

There is only a poor demand for finished iron and producers have little hope for the immediate future. Prices remain nominally unchanged, namely, £15 for marked bars, £13 for Crown bars, and £12 for nut and bolt iron. Willingness to shade the latter two figures fails to produce any important orders. Buying in this, as in other departments, is mainly for small special requirements. The nut and bolt trade continues to be poorly employed and has little use either for English or for Belgian material. A large proportion of the common bars, which are being worked up in the district, are of foreign origin. Continental material is dearer again this week at £8 10s. delivered. Hardly any business is being done, for the South Staffordshire industries are so badly off for orders that they are unable to consume the foreign material which they already have on hand.

Pig Iron Demand.

The quickened interest in pig iron noted in my letter last week is maintained. Consumers are inquiring with a view to covering forward requirements, and the sales effected are more encouraging. The demand is, however, more or less restricted to foundry sorts, and some ironmasters hesitate to draw too favourable omens from such expansion as recent weeks have brought. The undertone, however, appears to be steady. Prices remain at about £4 2s. 6d. for Northamptonshire foundry iron, and £4 5s. to £4 7s. 6d. for Derbyshire, whilst the North Staffordshire standard remains at about £4 10s. Many Derbyshire furnacemen who have refused to compete on the minimum terms hold that events are justifying their policy. At present, however, there are very few orders to be negotiated at anything better than rock-bottom prices. Sellers who quote £4 7s. 6d. for Derbyshire No. 3 say they are prepared to hold their surplus make, confident that the autumn will see an appreciable strengthening of the position, as it did in the two preceding years. In sales of forge iron there is little, if any, improvement. The state of the South Staffordshire iron industry does not encourage buying, and some firms have so far replenished their stocks that they will have sufficient material to meet any probable requirements in the near future. The general quotations for forge material on the market to-day were North Staffordshire, £4 2s.; Northamptonshire, £3 17s.; and Derbyshire, £4.

Steel Values.

There is a little movement, though a comparatively slight one in structural steel. The majority of the orders are still of very small bulk. As far as the contractors are concerned, this adds to the unprofitable character of the business, as the cost of staging and erecting plant cannot be reduced in anything like due proportion. Price cutting is prevalent in most departments, and values have fallen still further. Whilst the Association prices for angles and joists remains at £10, the competition of outside firms has brought the standard down to £9 10s., but even this figure is being freely shaded in order to obtain business. Belgian joists have advanced during the last three weeks about 10s. a ton, and are now quoted £6 10s. Small steel bars can be bought down to £9 10s., though some sellers continue to quote £10. Belgian bars are on offer at £7 10s. The hoop and strip departments are dull upon the whole, but demands from the motor trade have been maintained better than was expected, and during the past week there has been a little spurt in business. The trade in mild steel billets is so quiet that it is difficult to find a stable price basis. It is a fair deduction, however, that makers generally would not accept the £7 10s. price which is mentioned as the minimum. £7 12s. 6d. to £7 15s. are the figures more generally quoted. With the appreciation of the franc the quotation for Belgian billets continues to go up. The price now ruling is £6 15s. Some German material is being offered at about the same price. Quotations are given in francs, and the purchaser is left to take the risk of further alterations in exchange rates.

Scrap Values Weak.

Scrap material continues in rather slow demand. Heavy steel scrap could be obtained on 'Change in Birmingham to-day for a little over £4, and wrought iron scrap for £4 15s.

Sheets.

Business in galvanised sheets continues fairly satisfactory. Prices remain on the basis of £18 5s. per ton f.o.b. for 24-gauge corrugateds. New orders are coming in slowly, especially for home consumption. Black sheets, except for motor trade demands, are in somewhat poor request.

Steel Wire.

Midland wire mills, which up to a few weeks ago were working overtime, have experienced a slump in business. Buyers show a reluctance to place orders for forward delivery. They appear to be holding off in the expectation of lower prices, but warnings are being issued by manufacturers that prices are more likely to go up than to come down, as an increase in wages in all the departments affected is expected to take place as the result of the strike in Sheffield. Some buyers are beginning to take a similar view of the position and are now placing orders. A German invasion, the first of its kind it is said since the Armistice, has been experienced in the wire market. German mild steel wire for headings, used in the rivet trade, is being offered at £14 a ton delivered in Birmingham. The price of English wire of this quality is £16, with, in some cases, special prices for large quantities. The German quotation covers to the purchaser any possible increase of charge arising out of the return of the reparations duty to its former value.

Wages Advance.

Iron and steel masters in this district are pleased that at last negotiations have been satisfactorily concluded between the Iron and Steel Trades Employers' Association and the Iron and Steel Trades Confederation with regard to advances in the wages of the lower paid men. As the result of the agreement come to, the wages of the lower paid men will be increased by a special bonus commencing at 1s. 2d. per shift of eight hours for the lower paid workers. This advance in wages affects the lower-paid workers in the heavy steel trades who have been badly hit by the rapid fall in the price of steel, which has reflected itself in the sliding scale which governs wages.

Activity at Cannock Chase.

Miners in the Cannock Chase coalfield occupy the fortunate position of being fully employed. The coal trade in this area has shown considerable improvement during the past week or so, and most of the pits are now working practically full time. This unusual activity, at the present time of the year, is stated to be due to the fact that city merchants are already beginning to lay in stocks for the winter, and also, in some measure, to the absence this year of any prolonged spell of real summer weather. Short time employment at Cannock Chase has almost ceased. The number of colliery workers on the register at the Cannock Labour Exchange—partially employed—has been reduced to 18.

Black Country Chain Trade.

During the past half year there has been a distinct improvement in the export demand for chains, and the outlook in the Black Country chain trade is gradually improving, though the home demand still leaves much to be desired. It is interesting to note that the total amount of chain exported during the past six months was 8604 tons, as compared with 7039 tons in the same period of 1923, and 5302 tons in 1922. Though the figures for 1924 are higher than the previous two years, they represent only about 50 per cent. of what the export trade was in pre-war days.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Outlook.

THE general condition of the iron and steel markets shows no change, and the attitude of most people here is one of waiting to see what will turn up. A few people are of opinion that we have arrived at the worst and that there are one or two signs that the markets are beginning to mend, but it is certainly not possible yet to form any definite opinion. The hopes of an early improvement seem to be based partly upon a belief that the carrying out of the "Dawes scheme" will start European trade again and partly on rumours that a trade boom in America is near at hand. One is inclined to be sceptical as to any early recovery of European trade, but, of course, anything may happen in America. The trouble so far as British trade is concerned is that this country is no longer able to produce cheap goods, and one does not see how this disability is to be removed.

Metals.

There has been rather more inquiry here of late for the non-ferrous metals, and perhaps a little more actual business has been done. At any rate, merchants seem more cheerful, and this could scarcely be the case if there were no improvement in the demand. The fact that the slight advance in copper has been retained for over a fortnight has perhaps led to the belief that no further setback will be seen, and consumers of ingot copper are thus more disposed to buy for stock. No doubt some time must elapse before it is known whether the partial settlement of the reparations question will greatly increase the buying of copper in Europe, but American operators seem to be taking this view, and they claim that consumers in that country are relatively bare of stock, and that if there is the slightest danger of a serious advance they will all rush in to buy. Copper, of course, has been ripe for a rise for a very long time, and in the end it must come, and it may be worth while for large consumers here to keep a close watch on the market. So many disappointments have been met with during the last two years and so many abortive attempts have been made to "boost" the market and to scare consumers into action, that one can understand scepticism now. Nevertheless, it is well to remember the conclusion of the old "wolf" fable and to recollect that in the end the "wolf" did come. Tin remains a very uncertain market. Sellers here are still confident that the price has yet to advance and talk of an eventual £300 as probable before the end of the year; certainly the market seems to be establishing itself at the higher level of the last three weeks. There have been continual relapses, but after each the price seems to get a little higher. It seems to be expected that the demand from the American tin-plate trade will be better in a month or two, but one can say little about this until we see whether the "packing" trade is to be as good this autumn as it was last year. The outlook is quite too uncertain for any forecast, but so far those who took a "bullish" view seem to have been justified. The market for spelter has been slowly improving of late, but the prices are still comparatively low, although they are some 30s. per ton better than they were, and spelter has at last come up to the price of foreign lead. The latter market keeps up at a high level, and one cannot find that the demand shows any sign of falling off, in spite of the fact that the building trade is on strike.

Pig Iron.

The markets here for foundry pig iron are very quiet and dull still, but one does not know that they are any worse than they were, and one comes across a merchant here and there who maintains that they are slightly better. It has been reported that a certain amount of buying by merchants has taken place, and this is thought to indicate that some confidence in the market is being regained. Consumers, however, are still inclined to hold off, waiting for lower prices. Apparently it is not now possible to buy Derbyshire No. 3 foundry iron at much below 94s. delivered in Manchester. There was some done at 85s. per ton on trucks at the furnaces, and this would, of course, cost only about 92s. 6d. in this district; but if this iron is in the hands of merchants, of course, they will want a profit. The larger consumers here are hoping to get iron at 90s. in Manchester, but they may be disappointed unless a further slump should occur in the Cleveland iron market. Makers of Derbyshire iron are insistent upon the point that they have now reached the limit of what they can do in the matter of reducing prices, and that many furnaces must go out if the selling value is reduced any more. Lincolnshire foundry iron has certainly been sold to merchants to cost 93s. 6d. in Manchester, but the higher carriage from Northamptonshire prevents that iron from competing at 93s. 6d. Scotch No. 3 iron is again rather weaker here, in spite of the threat to blow out furnaces. About 108s. delivered seems all that can be obtained, and that only for small lots. There does not seem much disposition yet to buy large lots of Scotch iron.

Finished Material.

Trade in both iron and steel remains restricted. Of course, the price of finished iron is a great deterrent for the consumer. With steel costing from 50s. to 60s. per ton less than iron one cannot be surprised that the iron trade is bad. As for manufactured steel, the position does not appear to be any worse than it was. The prices remain at £9 5s. to £9 7s. 6d. for angles, £10 to £10 5s. for flat bars and plates, and up to £10 10s. and sometimes £10 15s. for round bars. These prices, or practically equal figures, have now been current for a long time. They are, of course, close up against the actual cost of production and in some cases below it.

Scrap.

The market here for scrap is more or less demoralised. There is very little buying in any direction, and dealers are very cautious how they offer for new parcels of material. Some dealers avoid buying steel scrap until they can see ahead more clearly. Roughly speaking, the dealers' prices in Manchester are 65s. for heavy steel melting scrap, or perhaps 67s. 6d.; 85s. for good machinery cast scrap delivered at foundries; and 87s. 6d. to 90s. for heavy wrought scrap.

John Downham.

Mr. John Downham, who died on the 15th inst. at his home, Malvern Villa, Chesham-road, Bury, after a brief illness, in his seventy-second year, was a well-known figure in engineering circles in the Manchester district. He served his apprenticeship with Messrs. Petrie, Rochdale, and later was a partner in the firm of J. Hacking Riley and Co., Elton. Afterwards he carried on a business under the title of J. Downham and Co. at Barnbrook Ironworks, Bury, but more recently acted in a consulting capacity. Mr. Downham was a member of the Manchester Association of Engineers. For many years he took an active part in local public affairs and in 1903 was appointed J.P. for the borough of Bury.

Colonial Trade Commissioners in Manchester.

The Trade Commissioners of the Dominions and Colonies at the Wembley Exhibition are visiting

Manchester this week to acquaint themselves with the chief industries of the district. They include representatives from India, Canada, Australia, New Zealand, South Africa, Newfoundland, Cyprus, Palestine, Ceylon, Nigeria, Gold Coast, Sierra Leone, Hong Kong, Fiji, Rhodesia, Bermuda, East Africa, and the West Indies. They arrived on Wednesday evening, and on Thursday visited the cotton mill of Richard Haworth and Co., and the engineering works of Armstrong, Whitworth and Co., Limited, Beyer, Peacock and Co., Limited, and Crossley Motors, Limited. In the evening they were entertained at a banquet at the Town Hall by the Lord Mayor and Corporation. To-day the great industrial area of Trafford Park will be visited, and while in the Park an opportunity will be given to the visitors to inspect the works of the Metropolitan-Vickers Electrical Company, Limited. In the afternoon visits to the Royal Exchange and the Chamber of Commerce will be made.

BARROW-IN-FURNESS.

Hematites.

The position of the hematite pig iron trade of this district is, if anything, not so good as it was, taking the area all round. Local steel makers at Barrow and Workington are taking fair supplies of pig iron for the time being, but how long that will be maintained is not at all sure, for in some cases orders for steel sorts are only lightly held. On general home account there is a quiet demand for iron and business is being carried on on a small scale. Overseas trade is dull. There has been a call on the part of users for an easing down in rates, but there is no variation of note this week. Manganese iron is a quiet trade and little is being done in spiegel.

Iron Ore.

There is less activity to report this week in the hematite iron ore trade. At the week-end the Hodbarrow Mines in South Cumberland closed down and will remain idle until there is a fuller demand for native ores. At other pits in both North Lancashire and Cumberland there is a want of activity, for the demand is almost wholly local. There is little being done in foreign ores.

Steel.

In the steel trade the activity is continued at Barrow, and this week the Siemens' plant, rail, merchant and steel foundries are engaged in the main works, and the hoop mills and special sections branches are well employed. At Workington the rail mill is on this week, but only for a short run. The general demand for rails is short and competition is keen. Hoops are a good trade, largely on overseas account.

Fuel.

There is a fair demand for fuel, coal and coke, the latter being drawn largely from the East Coast ovens.

SHEFFIELD.

(From our own Correspondent.)

Manufactured Steel.

In several of its branches the Sheffield steel trade proper continues to make progress. This is the case chiefly with the lighter side, embracing tools and tool steel. A prominent authority stated a day or two ago that more crucible steel had been melted in the city during the last ten months than during the previous two years. It is pleasant to know that there is a growing demand for the best qualities of tool steels. The advances in this department have not yet been large, but they are marked, and are being well held, and the outlook is considered good. An improved export trade is being done with some markets. The file trade is enjoying more activity than has been the case for some time. For farm and garden tools the season has been quite satisfactory, considering the disturbed conditions of the industry generally, and the trade in various other classes of tools keeps up to a good level. The heavier side of the Sheffield steel trade is mainly concerned at present with railway work, and, as I have previously reported, there is a good volume on hand from the British companies, but little from abroad, so that the axle, tire, and spring shops, although fairly well employed, are not called upon to exert themselves to the utmost.

The Heavy Steel Strike.

The heavy trade in mild semi-manufactured steel, although an important side of the industry of the immediate district, is not centred in Sheffield itself to any great extent. It is principally carried on just outside the city, especially in the Rotherham neighbourhood, and there it is at a standstill owing to the strike of workers which started a fortnight ago. Nearly forty large open-hearth furnaces at the three works concerned are standing idle, and the melting of steel has been altogether stopped. These works represent probably three-fourths of the trade in open-hearth steel in the district. The strike has come at a time when the trade was very depressed, and the firms which are unaffected by the wages trouble have not so far experienced any increase in demand. Steel users have very little material in stock, but they are not placing forward contracts, in view of the uncertainties of the time, and in the hope of further reductions in price. The strike has already had one interesting result, as it has produced a legal decision on a new question with regard to unemployment benefit. The strikers applied for benefit under a clause of the new Unemployment Insurance Act, which removes the old disqualification in cases in which a stoppage is due to the employers contravening the provisions of an agreement. The chief insurance officer rejected the claims, but a Court of Referees has decided in favour of the men—with the exception of the members of one union—employed by two of the firms affected by the dispute. The decision is being appealed against, and until the award of the umpire is received no benefit is being paid. An application with regard to the employees of the third firm is pending.

Houses of Cast Iron.

The question of the building of houses of cast iron plates has been raised by a Sheffield man's submission of a scheme to the Ministry of Health, which is now inquiring into it. The author of the scheme is Mr. J. A. Potter, of Attercliffe, Sheffield, and of the Tenter Foundry Company, Limited, Rotherham. He states his proposals are being considered by officials of the Ministry. Six of the houses are on the eve of being commenced on land at Rotherham. The exterior wall of the house, besides being a cavity wall, will be 5½in. thick. It is proposed that the houses shall be semi-detached and the cost is put at £550 per pair, excluding the land and drainage.

A Novel Hot Water Supply.

Several of the mining villages associated with the Staveley Coal and Iron Company enjoy the benefits of a novel scheme of hot water supply, which was originated by Mr. C. P. Markham, the chairman of the company. Instead of the water in the cottages having to be heated over the fire, it is laid on to the slopstones at temperatures of from 180 deg. to 200 deg. Fah. The arrangement is obviously full of convenience in all matters of washing, cooking and cleaning, and is highly appreciated by the miners and their wives. The hot water is developed by means of exhaust steam from the collieries, situated from 400 to 800 yards from the villages, passing through specially devised heaters, into which the cold water is fed. The heaters are composed of a series of brass tubes through which the water is forced by centrifugal pumps. When the water leaves the heater it is put into complete circulation throughout the whole of the houses by means of copper tubing. The scheme has been completed in Hartington, 50 houses; Speedwell, 275 houses; Woodcourt, 100 houses; and Netherthorpe, 112 houses. The water used is the ordinary town supply, so that if tea, coffee or cocoa is wanted the kettle can be filled from the tap and brought up to boiling point over the fire in quite a short time. A scheme on a different principle is now being installed in the village of Poolsbrook, where 398 houses will be supplied with hot water. In this case the steam will be developed in a boiler, the material used for heating being the refuse from the houses.

The Thorne Coal Find.

It is officially reported that the Barnsley seam, which was struck at a depth of 921¾ yards at Thorne new colliery, near Doncaster, last week, is 6ft. 9in. thick and that it is a valuable and workable seam. Another item of colliery news is mentioned in the report of the New Monckton Collieries, Limited, and is that during the past year the No. 4 shaft has been sunk down to the Haigh Moor seam and can be used for coal winding if desired. Electrical Distribution of Yorkshire, Limited, the South Yorkshire Electricity Order of which was confirmed by Parliament last week, has made arrangements for providing a supply of electricity for lighting to several new housing schemes in the colliery districts. One of them is at Airedale village, where some 800 houses will be supplied, and another at Stainforth and Hatfield, comprises 1100 houses. There are also schemes for Thorne, Darfield, the urban district of Hemsworth, and other places. The company's area comprises some 440 square miles, with a population of nearly 200,000. A bulk supply will be obtained from the Yorkshire Electric Power Company whose network of mains has enabled the Distribution Company to carry out its developments.

New Managing Director.

Mr. F. C. A. H. Lantsberry, who has recently been appointed managing director of William Jessop and Sons, Limited, the Sheffield steel firm, is a graduate of Manchester University and holds the degree of Master of Science for a metallurgical thesis. Jointly with Dr. Rosenhain, he is the author of the ninth report to the Alloys Research Committee of the Institution of Mechanical Engineers and has also written several papers on the properties and treatment of metals. He is a Fellow of the Institute of Chemistry.

Improvement in Cutlery Trade.

Although conditions in the cutlery trade are still far from normal or satisfactory, a continued improvement has been noticeable ever since the Easter holidays. A large proportion of the trade is still of the cheaper character, but at the same time there is a growing demand for goods of the better class, and some of the best houses have more work on hand now than they have had for a considerable time. The best Colonial market is Australia, with which, business is reported to be up to the normal; in India there is an improvement, though trade is not yet up to the average; South Africa has some leeway to make up; while the volume of orders from Canada is very small. The outlook for the colonial trade generally, is considered promising.

Wm. Jessop and Sons' American Interests.

In a recent issue the *Sheffield Telegraph* published an article containing a statement to the effect that Wm. Jessop and Sons, Limited, had sold their American interests. I now understand from the editor of that journal that, though the information on which that statement was made came from a usually reliable source, it was, actually, misleading and inaccurate, and that the real facts are as follows:—Wm. Jessop and Sons have for a long time been exporting to America and Canada, steel made at their works in Sheffield; in addition, they have owned all the stock in a company called the Jessop Steel Company of Washington, Pa., which company has been making, at its Washington factory, and selling some classes of steel in America and Canada. The demand for their Sheffield-made steel is so distinct from the demand for the American domestic product that Wm. Jessop and Sons have thought fit to sell their holding, consisting of all the stock in the Jessop Steel Company of Washington, to one who has for many years been on the board of the American company, but that sale is very far indeed from being a sale of all, or even the principal part, of their interests in America, and the Sheffield firm will continue to export steel to America and Canada as heretofore.

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Iron Trade.

It is still difficult to find an encouraging feature in the Cleveland pig iron trade. So far the anticipations of an expansion in the demand and the opening out of the autumn trade, which usually starts after the annual holidays, have failed to materialise. There seems to be a complete lack of confidence. Hopes of improvement have so often been falsified that nobody feels inclined to commit himself to forward contracts, and what business is being put through is entirely limited to immediate needs. Industrial requirements, moreover, are still very limited, and consequently home sales are very restricted. There have been rather better shipments abroad this month, but even so the total volume of iron shipped is quite small, and would need to be very substantially increased before the export trade could be said to be back to normal. The appreciation of the franc, however, has turned the scale in favour of British manufacturers in European markets, and if it continues the export trade should speedily benefit. Cleveland pig iron prices are sixpence per ton lower all round, No. 1 being 88s. 6d.; No. 3 G.M.B., 83s. 6d.; No. 4 foundry, 82s. 6d.; and No. 4 forge, 81s. 6d.

Hematite Pig Iron.

There seems to have been a little more hematite going away, but demand still falls short of the supply, and prices are weak. For East Coast mixed numbers 92s. 6d. per ton is about the market rate, and 93s. for No. 1, but producers are open to bargain with prospective buyers, and they would not allow a difference of 6d. per ton to stand in the way of a substantial sale.

Ironmaking Materials.

There is rather a divergence of opinion between sellers and consumers regarding the value of foreign ore. Sellers of the best Rubio ore still quote 22s. 6d. per ton c.i.f. Tees, but freights are very low, and it is affirmed that ore can be bought at 22s. per ton. There is, however, no business to test the market, and little prospect of any movement whilst the iron trade is so depressed. Some Durham coke makers still hold out for 26s. 6d. per ton for good medium furnace kinds delivered at the works, but others offer supplies at 26s. per ton.

Manufactured Iron and Steel.

The manufactured iron and steel trade presents few new features. Export inquiries are stated to be slightly better, and a few small overseas orders have been booked for early delivery, but contracts have been secured only after keen competition, and the ultimate acceptance of prices which leave practically no margin of profit. Home demand is on a low scale, and is restricted to negotiations for early requirements. Continental competition is less pronounced than it has been, but German producers continue to offer materials for export at comparatively low figures.

The Coal Trade.

There has been no great change in the position of the Northern coal trade this week with the exception that best qualities of steam coals have been in better demand for prompt delivery. The position at many of the collieries in Northumberland shows a slight improvement, but some are still working irregularly owing to the slackness in trade. In several instances they are well stemmed for the next week or so, and are therefore inclined to ask for higher prices than have prevailed during the last few weeks. Secondary sorts of steam coals are still slow of demand, and prices are as low as they possibly could be according to producers. Forward buying is on a very small scale. There are signs of the seasonal demand for gas coals beginning, but as yet inquiries and contracts are for very small lots. The Durham coal market is feeling the competition of German reparation coals. Advices from Rotterdam and Antwerp state that the market is flooded with German supplies. Vast numbers of lighters are lying fully loaded, and cannot find buyers for the stocks. This consequently checks the demand for North Country coals, and especially bunker qualities. It is stated that in order to quote prices which will compete with coaling stations along the English Channel, a bunkering firm is seeking orders for best Westphalian coal at 24s. per ton f.o.b., which is lower than present bunker prices at Rotterdam. The demand for coke for prompt shipment is slow, and stocks are fairly large, but makers hold out for recent prices.

SCOTLAND.

(From our own Correspondent.)

Disappointing Conditions.

The passing of time has not yet brought the long-desired industrial improvement, and markets, on the whole, are dull and uninteresting. Buyers cannot be induced to cover beyond strictly immediate requirements, and these are exceptionally small at present. Foreign producers, too, are obtaining fair proportions of the orders that come forward, home makers being evidently unable to give sufficient inducement in the nature of price reduction. If it were not for the firmer position of the exchanges on the Continent, this competition would almost assuredly be more deadly. At any rate,

the home trade is in a most discouraging position, and it is hoped that the London Agreement will be instrumental in placing finance and business on a more stable foundation.

Pig Iron.

There is very little of a fresh nature to report in connection with the pig iron market. Steel works take small supplies of hematite, and foundries also are purchasing most sparingly. Prices are practically on last week's level, but a better price could be obtained for any substantial order. The export demand shows a little expansion now and then, but a permanent improvement seems as far off as ever. The output is comparatively low, but is equal to all demands. The situation may be gauged from the fact that only 25 furnaces are in blast compared with about 85 in normal times.

Steel and Iron.

Generally speaking, business in steel has been reduced to small dimensions. Specifications for plates are extremely difficult to obtain, and the position of sections is little, if any, better. Shipyard orders are especially disappointing, and in this class of material the foreigner seems to be obtaining the bulk of the small turnover at present circulating. The market for light steel sheets, too, is not quite so brisk. Makers, however, are well placed for a month or two at least. No changes of prices has been reported in steel material. Mention of the bar iron industry only involves a repetition of the story of the lack of fresh business. Makers have considerable difficulty in securing enough business to preserve even a minimum amount of employment, and the outlook is most unsatisfactory. A little more business is being done in the re-rolled steel department of this industry, while the price remains about £9 10s. to £9 15s. per ton home or export. The scrap trade is comparatively idle, not only because of the general dulness but because of an expectation that prices may go considerably lower before long.

Coal Market Quieter.

The general demand for coal has been rather quiet during the past week. The number of steamers coming forward for cargoes has become fewer, and prompt business has shrunk accordingly. However, Lanarkshire ells have sold up to 20s. 6d. per ton, and splints to 24s. per ton. Treble nuts in this district have eased a shade, but are generally sold round about last week's figure of 22s. 6d. per ton. Ayrshire fuels have sold fairly well. Fifeshire navigations continue firm and best steams are well placed, but secondary qualities have eased. Treble nuts were a good market. Material from the Lothians has not been too busy, and some qualities have been sold freely at cheaper prices. Double and single nuts and smaller stuffs have eased in all districts. No increase in forward business is reported. Buyers still hold out for prices somewhat below the colliery quotations and appear certain of ultimate success. The home market remains slow. Industrial requirements are still far below normal, and household fuel is selling pretty much on the summer basis.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

On the whole there has been no material alteration in the general state of the coal trade and the outlook is no better. Few, if any, people interested in the export side of the industry can see the silver lining to the cloud overhanging trade. At the end of last week a striking speech on the situation and the prospects was made by Mr. W. North Lewis, the chairman of the Windsor Steam Coal Company, who is also a past president of the Cardiff Chamber of Commerce. He said that, speaking with a considerable experience of the coal trade behind him, he did not remember the time when the outlook seemed more unpromising, and described the agreement recently forced upon the coal trade as burdensome in the extreme and likely to prove disastrous to the coalowners and men. His speech was very disturbing, especially to holders of colliery shares; but it is safe to say that Mr. North Lewis is not alone in his views, and although economists and others have predicted a revival in trade amounting to a boom, there is unfortunately no evidence of it in this district. As a matter of fact it is questionable whether there was ever a time when the coal trade was so quiet, and at the same time shipowners were experiencing such unremunerative conditions. It is not only that outward rates of freight are so depressed, but the amount of homeward business is so restricted that shipowners are in many cases making dead losses. It is quite true that, so far as the coal trade is concerned, prices on the market are being maintained, but it is at the expense of the closing of a number of collieries and of the more expensive workings at others, and numerous miners are unemployed. Still, although the conditions are so depressing, hope is not abandoned of an improvement, and the coal trade is notorious for quick changes.

South Wales Agreement.

It was fully expected that the South Wales Coal Conciliation Board agreement would have been signed by this time, seeing that the national agreement was fixed up several months ago; but it looks now as if this matter is to be held up for a further period. The Executive Council of the South Wales Miners' Federation gave consideration on Monday last to the report of the sub-committee which has been negotiating with the Coal Owners' sub-committee in regard to the drafting of the new agreement and the question of the adjustment of some anomalies as provided for in the national agreement, but after hearing the reply of the owners to the various questions raised it was decided that a delegate conference should be called in order to put the whole matter before the workmen.

Coalfield Items.

The miners at the Cambrian collieries at Clydach Vale are now idle and number about 3500. Unfortunately, the stoppage of work will, it is feared, be a rather lengthy one. In the Garw Valley the good news has been received that the International Colliery, which has been idle since the 2nd inst., will re-start on Monday next, so that about 1000 miners will find employment. There is also a better prospect as regards the continuance of work at the Hills' Plymouth Colliery continuing after this week. The company recently determined to temporarily close down the No. 1 South Pit at Pentrebach, which affects about 1000 men, and the notices to the workmen to terminate their contracts expired at the end of this week; but as the result of negotiations between the men's leaders and the management it is reported that ways and means have been found of securing a material increase in the output, so that it is probable that the operation of the notices will be suspended.

Strike at the Dry Docks.

The members of the Amalgamated Engineering Union employed at the South Wales dry docks and engineering yards connected with ship repairing are still idle, and unfortunately there is no sign of any approach being made towards a settlement of the dispute on the wages question. The conditions in the industry are naturally very quiet, as ship repairing firms are unable seriously to entertain work which requires the attention of the fitters, coppersmiths and others, and, on the other hand, shipowners are equally reluctant to consider having any repairs carried out in this district, except very minor requirements which are not likely to cause any detention to steamers. It is difficult to say exactly how many workmen are really affected by the present stoppage, as others besides members of the Amalgamated Engineering Union by this time are rendered idle on account of the action of the fitters, &c., and, of course, slackness of trade will account for some unemployment. All the ports in this channel, including Avonmouth, are affected by the dispute. At Swansea a few firms are understood to be prepared to pay the wage demands of the members of the Amalgamated Engineering Union, but these firms are not members of the South Wales Dry Dock and Ship Repairers' Association, and the number of workmen employed by them is not substantial. It has been ruled that the members of the Amalgamated Engineering Union are not entitled to unemployment benefit, but the officials are appealing against this decision.

Current Business.

The steam coal trade continues to be quiet and market conditions display no material change, except that the superior grades of steam coals are firm on account very largely, of the suspension of work at the Cambrian pits. Best Admiralty large coals command 28s. 6d. to 29s., but one or two of the undertakings producing the best coals are so fully booked up that they have no coals to offer for sale for the whole of next month, and consequently the price is little more than nominal. Other coals are no more than steady and the inquiry from abroad is comparatively small. Steam small coals are rather more plentiful and values are barely upheld, but in the anthracite section the tone is good and collieries are fairly well off for orders. Most grades of coal are very steady.

Catalogues.

SULZER BROS., 31, Bedford-square, W.C. 1.—Catalogue on Sulzer refrigerating plant.

GEORGE ELLISON, Perry Barr, Birmingham.—Pamphlet on electric circuit breakers.

ATELIERS DE CONSTRUCTIONS ELECTRIQUES DE CHARLEROI.—List of motors and dynamos in stock.

MELDRUMS, Limited, Timperley, near Manchester.—Booklet entitled "Through the Furnace Door."

MANLOVE, ALLIOTT AND CO., Limited, Nottingham.—Folder giving illustrations of laundry machinery.

COCHRAN AND CO. (Annan), Limited, Annan, Scotland.—Illustrated art calendar. Weekly tear-off sheets.

S. G. LEACH AND CO., Limited, 26–30, Artillery-lane, London, E.C.—List L.G. 1 of the firm's electrical specialities.

THOS. W. WARD, Limited, Albion Works, Sheffield.—Booklet containing selected pages from the firm's catalogue.

SHELL-MEX, Limited, Shell Corner, Kingsway, London, W.C. 2.—Leaflet dealing with Class A transformer oil.

RUSTON AND HORNSBY, Limited, Lincoln.—New edition of cold-starting oil engine catalogue, publication No. 4630.

THE NATIONAL GAS ENGINE COMPANY, Limited, Ashton-under-Lyne.—Illustrated catalogue of heavy oil engines.

MCGRAW-HILL PUBLISHING COMPANY, Limited, 6, Bouverie-street, London, E.C. 4.—List 5 (July, 1924) of books on civil engineering.

COOKE-FOX PATENT FURNACE COMPANY, 55, Cecil-road, Sharrow, Sheffield.—Illustrated leaflet on the Cooke-Fox patent furnace cover.

LONDON HYDRAULIC POWER COMPANY, Hatfield-street, Southwark, S.E. 1.—Map of London showing the lines of the company's mains.

H. W. WARD AND CO., Limited, Dale-road, Selly Oak, Birmingham.—Illustrated catalogue (edition 24 abridged) of capstan and turret lathes.

THE E. J. CODD COMPANY, 700/708, S. Caroline-street, Baltimore, Ind.—Bulletin discussing the employment of chain shadow pans in glass works.

BRITISH ALUMINIUM COMPANY, Limited, 100, Queen Victoria-street, E.C.4.—Booklet No. 20, hints on working aluminium, aluminium sheets and circles.

G. A. HARVEY AND CO. (London), Limited, Suffolk House, Laurence Pountney-hill, London, E.C. 4.—List No. 317 giving prices of steel vertical filing cabinets.

AUTOMATIC AND ELECTRIC FURNACES, Limited, Elecfurn Works, 173–175, Farringdon-road, London, E.C. 1.—Leaflet on electric furnaces with internal heaters (radiant heat type.)

DOULTON AND CO., Limited, Lambeth, London, S.E. 1.—A delightfully illustrated volume entitled "The Royal Doulton Potteries: A Brief Summary of their Rise and Expansion during Six Reigns."

BOSTOCK AND BRAMLEY (in association with Joshua Buckton and Co., Limited), Dewsbury-road, Leeds.—Pamphlets on enveloping worm gear and the Bostock-Bramley-Buckton power transmission gearing.

ATELIERS DE CONSTRUCTIONS ELECTRIQUES DE CHARLEROI, 56, Victoria-street, S.W. 1.—Catalogue No. 201 on Type C.A. three-phase induction motors. List of motors and dynamos in stock July. Copy of the *A.C.E.C. Review*.

SHELL-MEX, Limited, Shell Corner, Kingsway, W.C. 2.—Pamphlet entitled "Modern London. Progress Towards a Smokeless City." Details of where boilers have been fitted with oil burning apparatus and use Mex fuel oil are given.

DEMAG, Duisburg.—Illustrated catalogue in three parts:—(i.) Construction of waterways and harbour basins; (ii.) loading, discharging and conveying plant for the rapid handling of cargo; (iii.) installations for the upkeep of ports and ships.

THE BRITISH THOMSON-HOUSTON COMPANY, Limited, Rugby.—Descriptive list No. 5022–A, dealing with direct-current drum controllers and resistances, and Price Supplement No. 5022, giving prices of combined controllers and resistances for direct-current motors.

RUSTON AND HORNSBY, Limited, Lincoln.—Illustrated pamphlet on widening the river Nene between Peterborough and Wisbech with a Ruston No. 10 dragline. Publication 4634, giving details of where the Ruston cold-starting oil engine is installed in this country. Some reports and tests on horizontal and vertical engines by users is included.

JAMES KEITH AND BLACKMAN COMPANY, Limited, 27, Farringdon-avenue, London, E.C. 4.—Folders on the following subjects:—(i.) Keith-Blackman electric forge blower; (ii.) Keith O.C. domestic service boiler; (iii.) Blackman fans for drying hops; (iv.) some problems of the woollen trade and some suggestions for their solution; (v.) some problems of the modern launderer and some suggestions for their solutions; (vi.) subjects of particular interest to colliery owners, managers, agents, and engineers.

LAUNCHES AND TRIAL TRIPS.

BARRINGTON COURT, steamer; built by Workman, Clark and Co., to the order of Haldin and Co., Limited; dimensions, 410ft. long; 4900 gross tonnage. Engines, single-screw vertical inverted direct-acting surface-condensing triple-expansion; constructed by the builders; launch, August 14th.

BRITISH MOTORIST, single-screw motor ship; built by Swan, Hunter and Wigham Richardson, Limited; to the order of the British Tanker Company, Limited; dimensions, 454ft. by 57ft. beam. Engines, "Neptune" marine oil, reversible 2-cycle single-acting; constructed by the builders; launch, August 14th.

ELFSTONE, single-screw self-trimming collier; built by Swan, Hunter and Wigham Richardson, Limited; to the order of the Crete Shipping Company, Limited; dimensions, 335ft. by 36ft. by 17ft. 6in.; 2100 tons deadweight. Engines, triple-expansion; constructed by the builders; trial trip, August 14th.

PALLAS, oil tank vessel; built by Ateliers and Chantiers de Sud Ouest; to the order of Compagnie Auxiliaire de Navigation; dimensions, 390ft. by 53ft. by 31ft.; 8000 tons deadweight. Engines, triple-expansion, 27in., 44in., 73in. by 48in. stroke; pressure, 180 lb.; constructed by John G. Kincaid and Co., Limited; launch, August 16th.

GERALDINE MABY, single-screw cargo steamer; built by Vickers Limited, Barrow-in-Furness; to the order of the Anglo-Newfoundland Development Company; dimensions, 422ft., 56ft. moulded, and 38ft. 6in. moulded to upper deck; to carry 9000 tons deadweight. Engines, triple-expansion, 26½in., 44in. and 74in. by 54in. stroke, pressure 200 lb. per square inch; constructed by the builders; the holds of the vessel have been specially designed for carrying rolls of paper 2ft. 9in. in diameter and 6ft. long, and her fore end has been specially formed for ice-breaking purposes; launch, August 19th.

SAVITRI, sailing motor yacht; built by John I. Thornycroft and Co., Limited, Southampton, to the order of His Highness the Jam Sahib of Nawanagar; dimensions, 70ft. long; constructed by the builders; launch, August 20th.

NITEDAL, steamer; built by Wm. Gray and Co., Limited, to the order of Dampskibsaktieselskapet Ostlandet, Kristiania; dimensions, 368ft. 6in. by 50ft. by 27ft. Engines, triple-expansion, 25in., 40½in., 67in. by 45in. stroke, pressure 180 lb.; constructed by the builders; trial trip, August 22nd.

SILVERLARCH, motor ship; built by Swan, Hunter and Wigham Richardson, Limited, to the order of the Mount Steamship Company, Limited; dimensions, 400ft. by 53ft. 3in. by 28ft. 9in.; 8400 tons deadweight. Engines, reversible two-cycle single-acting six-cylinder oil; constructed by the builders; trial trip, August 25th.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

R. H. LONGBOTTOM AND CO., Limited, asks us to announce that their offices are now at 22, Northumberland-avenue, London, W.C. 2. Telegrams: Ahnuychel, Westrand, London; and telephone: Regent, 1599.

SCHOLEY CONSTRUCTION COMPANY, Limited, of 137, Victoria-street, Westminster, London, S.W. 1, inform us that Mr. J. Ferguson, late chief engineer of the Glasgow Corporation Tramways, has been appointed to represent it in Scotland in connection with the Sandberg "Insitu" rail hardening process.

THE ELECTRIC FURNACE COMPANY, Limited (formerly Campbell Gifford and Co., Limited), of 17, Victoria-street, London, S.W. 1, informs us that arrangements have been made by which Automatic and Electric Furnaces, Limited and it will jointly design Wild-Barfield internally-heated electric furnaces, having an input greater than 25 kilowatts, which in future will be supplied by it; and that arrangements have also been made with George J. Hagan Company, of Pittsburg, who have constructed a large number of electric resistance furnaces up to 350 kilowatt capacity, for the use of their drawings and information, so that the best British and American practice may be incorporated in the designs.

TENTH EXPOSITION OF CHEMICAL INDUSTRIES.—Owing to some confusion which is believed to exist in a few quarters regarding the holding of the next chemical exposition, the International Exposition Company, under the management of which the Exposition of Chemical Industries has been held since 1915, asks us to state that, numerous inquiries having been received which leads it to believe that many interested parties are of the opinion that there will be a Chemical Exposition this year, there will be no Chemical Exposition in 1923, but that the next Exposition of Chemical Industries will be held September 28th to October 3rd, 1925, at the Grand Central Palace, New York.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	17/6 to 24/–
(1) Spanish	23/–
(1) N. African	23/–
N.E. Coast—	
Native	—
Foreign (c.i.f.)	22/–

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	4 16 3	—
No. 1 Foundry	4 18 9	—
No. 3 Foundry	4 13 9	—
N.E. Coast—		
Hematite Mixed Nos.	4 12 6	4 12 6
No. 1	4 13 0	4 13 0
Cleveland—		
No. 1	4 8 6	4 8 6
Silicious Iron	4 8 6	4 8 6
No. 3 G.M.B.	4 3 6	4 3 6
No. 4 Foundry	4 2 6	4 2 6
No. 4 Forge	4 1 6	4 1 6
Mottled	—	—
White	—	—
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	9 2 6	—
North Staffs. Forge	4 2 0	—
,, ,, Foundry	4 10 0	—
(3) Northampton—		
Foundry No. 3	4 2 6	—
,, Forge	3 17 0	—
(3) Derbyshire—		
No. 3 Foundry	4 5 0 to 4 7 6	
Forge	4 0 0	—
(3) Lincolnshire—		
No. 3 Foundry	4 10 0 to 4 12 6	—
No. 4 Forge	4 6 to 4 8 0	—
Basic	4 5 0 to 4 10 0	
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	5 10 0 (a) / 5 15 0 (b)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	12 10 0	—
Best ,,	—	—
N.E Coast—		
Common Bars	12 10 0	—
Lancs —		
Crown Bars	13 0 0	—
Second Quality Bars	12 0 0	—
Hoops	15 0 0	16 15 0
S. Yorks.—		
Crown Bars	13 10 0	—
Best ,,	14 0 0	—
Hoops	15 0 0	—
Midlands—		
Crown Bars	13 0 0	—
Marked Bars (Staffs.)	15 0 0	—
Nut and Bolt Bars	12 0 0	—
Gas Tube Strip	13 5 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	13 10 0	—
Ship Plates, ¼in. and up	10 5 0	—
Sections	10 0 0	—
Steel Sheets, 3/16in. to ¼in.	12 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	18 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	9 15 0	—
Angles	10 0 0	—
Boiler Plates	13 10 0	—
Joists	10 0 0	—
Heavy Rails	9 0 0	—
Fish-plates	13 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	9 10 0	—
Soft Billets	8 10 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	9 5 0†	
Light ,,	9 10 0 to 10 0 0†	
Billets	8 10 0 to 12 0 0†	
Manchester—		
Bars (Round)	10 5 0 to 10 15 0	
,, (others)	10 0 0 to 10 2 6	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	13 15 0	13 10 0
Plates	10 0 0 to 10 5 0	—
,, (Lancs. Boiler)	13 10 0	—
Sheffield—		
Siemens Acid Billets	12 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	9 10 0	—
Intermediate Basic	9 0 0	—
Soft Basic	8 5 0 to 8 10 0	
Hoops	12 10 0 to 13 0 0	
Soft Wire Rods	11 0 0 to 11 10 0	
Midlands—		
Small Rolled Bars	9 10 0 to 10 0 0	
Billets and Sheet-bars	7 12 6 to 7 15 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	18 5 0	—
Angles	9 10 0 to 10 0 0	
Joists	9 10 0 to 10 0 0	
Tees	10 10 0 to 11 0 0	
Bridge and Tank Plates	10 10 0	—
Boiler Plates	14 0 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	23/– to 23/3
Block Tin (cash)	£50 10 0
,, (three months)	£51 15 0
Copper (cash)	£63 12 6
,, (three months)	£63 12 6
Spanish Lead (cash)	£32 10 0
,, (three months)	£31 15 0
Spelter (cash)	£32 12 6
,, (three months)	£32 12 6
Manchester—	
Copper, Best Selected Ingots	£69 0 0
,, Electrolytic	£70 0 0
,, Strong Sheets	£94 0 0
,, Tubes (Basis price)	£0 1 1½
Brass Tubes (Basis price)	£0 1 0
,, Condenser	£0 1 2½
Lead, English	£34 10 0
,, Foreign	£33 15 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8½ per lb.	
Ferro Tungsten	1/4½d. per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 0 0	10/6
,, 6 p.c. to 8 p.c. ,,	£23 10 0	8/–
,, 8 p.c. to 10 p.c. ,,	£23 0 0	8/–
,, Specially Refined		
,, Max. 2 p.c. carbon	£42 10 0	16/–
,, ,, 1 p.c. ,,	£51 0 0	17/6
,, ,, 0.75 p.c. carbon	£68 0 0	20/–
,, ,, carbon free	1/5 per lb.	
Metallic Chromium	4/2 per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/– per unit	
,, ,, 75 p.c.	£18 10 0 scale 6/– per unit	
,, Vanadium	10/3 per lb.	
,, Molybdenum	8/3 per lb.	
,, Titanium (carbon free)	1/3 per lb.	
Nickel (per ton)	£135	
Cobalt	10/6 per lb.	
Aluminium (per ton)	£120 to £130	

FUELS.

Scotland.	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	18/9
,, ,, Ell	20/–
,, ,, Splint	21/6 to 24/–
,, ,, Trebles	22/6
,, ,, Doubles	19/–
,, ,, Singles	18/–
Ayrshire—	
(f.o.b. Ports)—Steam	18/9
,, ,, Splint	21/6
,, ,, Trebles	22/6
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	16/9 to 20/3
Screened Navigation	26/–
Trebles	24/–
Doubles	18/3
Singles	16/–
Lothians—	
(f.o.b. Leith)—Best Steam	18/3
Secondary Steam	17/3
Trebles	23/–
Doubles	18/3
Singles	16/–
England.	
(8) N.W. Coast—	
Steams	28/6
Household	48/– to 58/4
Coke	33/6
Northumberland—	
Best Steams	20/9
Second Steams	18/6 to 19/–
Steam Smalls	10/6
Unscreened	16/– to 17/–
Household	27/6
Durham—	
Best Gas	23/6
Second	18/6 to 19/–
Household	27/6
Foundry Coke	25/– to 26/–
Sheffield—	Inland.
Best Hand-picked Branch	32/– to 35/– —
Barnsley Best Silkstone	26/– to 28/– —
Derbyshire Best Brights	25/– to 27/– —
,, ,, House	23/– to 23/– —
,, ,, Large Nuts	21/– to 25/– —
,, ,, Small ,,	15/– to 17/6 —
Yorkshire Hards	21/6 to 22/6 —
Derbyshire ,,	21/– to 23/– —
Rough Slacks	12/6 to 15/6 —
Nutty ,,	12/– to 14/– —
Smalls	6/– to 8/6 —
Blast-furnace Coke (Inland)*	— —
,, ,, (Export)	f.o.b. 27/–
Cardiff—	(9) SOUTH WALES.
Steam Coals:	
Best Smokeless Large	28/6 to 29/–
Second ,, ,,	27/– to 28/–
Best Dry Large	26/6 to 27/–
Ordinary Dry Large	25/– to 26/–
Best Black Vein Large	26/6 to 27/–
Western Valley ,,	26/– to 26/6
Best Eastern Valley Large	25/– to 26/–
Ordinary ,,	24/– to 25/–
Best Steam Smalls	17/– to 18/–
Ordinary ,,	14/6 to 16/6
Washed Nuts	25/– to 27/–
No. 3 Rhondda Large	27/– to 28/–
,, ,, Smalls	20/– to 22/–
No. 2 ,, Large	23/– to 24/–
,, ,, Through	19/– to 21/–
,, ,, Smalls	14/– to 15/–
Foundry Coke (export)	47/6 to 55/–
Furnace Coke (export)	52/6 to 37/6
Patent Fuel	27/– to 29/–
Pitwood (ex ship)	30/– to 31/–
Swansea—	
Anthracite Coals:	
Best Big Vein Large	50/– to 52/6
Seconds	42/6 to 45/–
Red Vein	30/– to 32/6
Machine-made Cobbles	57/6 to 60/–
Nuts	55/– to 62/6
Beans	40/– to 42/6
Peas	23/– to 25/–
Breaker Duff	10/9 to 11/3
Rubbly Culm	13/6 to 14/–
Steam Coals:	
Large	23/– to 24/–
Seconds	22/– to 23/–
Smalls	15/– to 18/6
Cargo Through	18/– to 20/–

(1) Delivered (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/– extra delivered England.

(7) Export Prices—f.o.b. Glasgow.

(8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o b. for export. (9) Per ton f.o.b.

* For blast furnaces only, 21/– to 25/–; open market, 27/6 to 28/6. † Latest quotations available. (a) Delivered Sheffield or Glasgow. (b) Delivered Birmingham

French Engineering Notes.

(From our Correspondent in Paris.)

The German Treaty.

The negotiations for a treaty of commerce with Germany, whereby raw and manufactured material is to be supplied on account of reparations, are already giving rise to objections amongst makers who fear that the importation of German goods will cause a prejudice to the French industry. A case in point is the statement that the French Government has placed orders in Germany for a number of locomotives and a large quantity of railway material. Seeing that the home locomotive and wagon builders have for a long time been almost destitute of work, the ordering of material in Germany on account of reparations has aroused a very strong protest. The Government admits that there have been preliminary negotiations with German locomotive and wagon building firms, but declares that no orders have been placed, nor will anything be done before consulting the various industries interested. Nevertheless, the Government makes it clear that manufacturers must be prepared to consent to certain sacrifices for the benefit of the community, which probably means that financial considerations will have more weight than industrial interests. In the same way, strong efforts will be made to induce Germany to carry out the greater part of the vast scheme of public works which was presented by M. le Trocquer, the late Minister of Public Works, involving an expenditure of 19,000 million francs, of which Germany would pay two-thirds in wages and material, the idea being that canal, railway and hydro-electric undertakings put in hand with the aid of German labour and material, would benefit the home industries without incurring the risk of competition. The proposal, however, was rejected by the German Government in 1922, and there is very little hope of its meeting with a better reception now. The principle underlying the proposed treaty of commerce is that Germany shall supply coal and coke and facilitate the importation into that country of goods from Alsace and Lorraine, which provinces would find it very difficult to dispose of their products in France. Manufactured goods are to be supplied to France on account of reparations on condition that the goods do not necessitate the importation of raw material. It is obviously quite impossible to impose restrictions of this kind, and there is a general feeling that any treaty of commerce with Germany will necessarily give to that country certain facilities for doing business here. The fact that Germany will be free to fix any import duties she pleases in January next strengthens her hand very considerably. France must have coal and coke on account of reparations, and she will have it under certain conditions favourable to Germany, and as it is feared by French manufacturers that they will find themselves involved finally in a severe competition with German goods it is suggested whether, after all, it would not be better to carry through a treaty of commerce in which Great Britain, Belgium and, perhaps, Italy, as well as France, would be partners. In other words, a general treaty of commerce would offer more guarantee of protection against competition than an individual treaty carried out under conditions which are liable to give Germany an undue advantage.

Light Car Construction.

The motor car industry is developing so rapidly in the direction of the light car that that branch of construction is already overshadowing other departments of the trade. Beginning with the cyclecar, engines were employed running at very high speeds with a corresponding reduction of weight per horse-power, and the results obtained were so good that engines of rather more power were introduced for the light car, with a maximum efficiency at between 3000 and 4000 revolutions per minute and, in some cases, even more. Thus, a 1100cc. engine develops normally about 20 horse-power. The same thing is, of course, noticeable in the bigger vehicles, the engines of which are rated at about one-third of what they were formerly, although giving the same power. The effect of this reduction of weight has been to put more engine power into the light cars, which have become so popular that some firms have had considerably to increase their production.

Seamen's Strikes.

The periodical strikes of seamen and dockers at Havre and other ports are becoming so embarrassing that there is no longer any certainty about the departure of ships. For some time past the shipping has been partly held up at Havre by a strike of seamen who claimed an increase of 5 francs a day in wages. Half that amount was offered them and refused. The big steamers could only leave by completing the complement of hands with men from the navy. The shipowners are so hampered with restrictions in competing for freights that they are obliged to resist these repeated demands for higher wages. It is hoped that a settlement will soon be arrived at over the question of the eight hours' day, the Government having decided to arrange a conference of shipowners and seamen and official representatives.

Commercial Aeroplanes.

For the competition of commercial aeroplanes organised by the Air Ministry only three machines qualified—the Farman monoplane, with four Hispano-Suiza engines, developing altogether 720 horse-power; the Blériot, with four Salmson air-cooled engines of 920 horse-power, and the Caudron, with three Salmson engines, one central and two lateral. The classification was based upon a formula which took into account the load, average speed and engine power. The test consisted of three separate return journeys between Le Bourget and Bordeaux making a total distance of more than 3000 kiloms. The Farman, with a wing surface of 81 square metres and carrying a load of 850 kilos., effected the journeys with remarkable regularity at an average speed of 179.4 kiloms. per hour. The load carried by the Blériot, with a wing surface of 126 square metres, was 1003 kilos., and the average speed attained was 146 kiloms. The first prize was awarded to the Farman machine. The Caudron failed to do the journey on the first two days.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

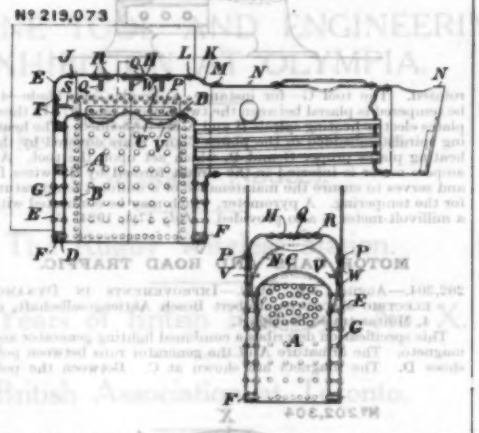
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

219,073. April 14th, 1923.—Improvements in Steam Boilers, Aveling and Porter, Limited, and Thomas Lake Aveling, both of Invicta Works, Rochester, Kent.

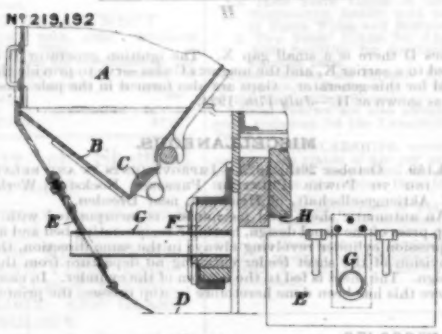
This invention relates to boilers, particularly those having a fire-box of the Belpaire type, in which the boiler has a foundation frame to which the boiler plates are riveted and a corrugated plate forming the crown of the boiler and has bent-over edges, which are riveted to the ends of the fire-box plates. The main object of this invention is to construct boilers of interchangeable parts, which can be made in the shop and be assembled together by unskilled operators. A are fire-box plates having machined edges which are drilled to jig, and they have bent-over top ends to which a corrugated plate C is secured by rivets B, thus forming the crown and sides of the fire-box. D is a frame to which the fire-box plates A and the shell plates E are secured by rivets F, after the crown and side plate C have been



riveted to the plates A. Corresponding stay holes are then tapped in both sets of plates A and E, and they are fitted with threaded stays G, which are screwed into the holes to any desired length by a stud driver, and are pneumatically or hydraulically riveted. The roof of the outer shell consists of a plate H, having machined edges, and the sides are secured to the bent-over tops of the plates E by rivets J and to the plate K by rivets L, the plates K being secured by rivets M to plates N surrounding the boiler tubes. The other sides of the roof plate H are bent over and secured by rivets P to the side plates E of the shell. Transverse bars Q of T section, and having stems of segmental form, are secured to the roof plate H by rivets R and to the top of the front plates E, and T-shaped bars V are secured by rivets W to the side plates of the shell below the joints of the side plates and the roof.—*July 14th*, 1924.

219,192. August 16th, 1923.—Improvements in and connected with Steam Generators, Babcock and Wilcox, Limited, and Sir James Kemnal, F.R.S.E., both of Babcock House, Farringdon-street, London, E.C. 4.

This invention has for its object to provide an improved arrangement whereby the ordinary coal firing may be supplemented or conveniently and rapidly replaced by oil firing. The arrangement is particularly adapted for use with low-grade solid fuel which cannot be burnt sufficiently rapidly to keep hot the usual arch, and which for this reason cannot ordinarily be used in furnaces of steam generators, the oil being sprayed under the arch in order to maintain it sufficiently hot to permit the use

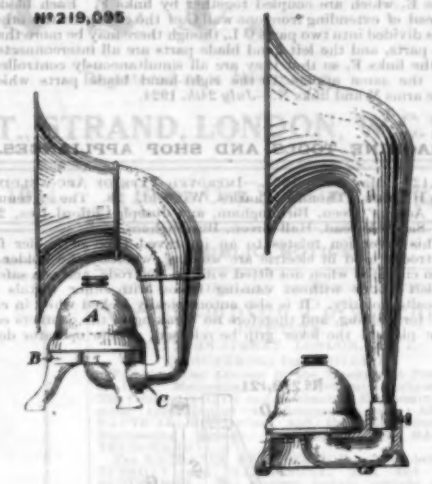


and early ignition of such low-grade fuel. A denotes the usual fuel hopper for feeding the chain grate, the hopper being fitted with the usual shutter plate B and shutter C. D denotes the usual chain grate stoker, E the hopper apron, F the guillotine door, and G the tube extending from the exterior of the furnace through the apron E and door F into the combustion chamber. This tube G, or a similar arrangement, serves as a housing for an oil fuel burner—not shown—for leading the oil to a point beneath the arch H. The arrangement is such that the apron E is movable with the guillotine door.—*July 24th*, 1924.

TELEGRAPHS AND TELEPHONES.

219,095. April 19th, 1923.—Improvements in Sound Emitting or Transmitting Instruments, The British Thomson-Houston Company, Limited, Crown House, Aldwych, London, W.C. 2, and John Henry Butcher, of 15, Caldecott-street, Rugby.

According to this invention, a compact design of loud-speaking telephone is obtained by coiling the sound horn around a portion of the instrument in such a way that the centre of gravity of the sound horn is substantially vertically over the centre of gravity of the instrument. Two methods of carrying out the invention are illustrated in the accompanying drawings. A telephone receiver or loud speaker A is mounted upon a stand B, between two legs of which—see the left-hand illustration—the neck C for a sound horn passes, and is arranged to spread out

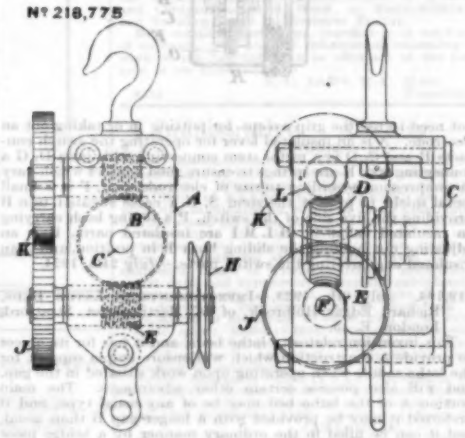


above the instrument A in the manner shown. In the case of the right-hand illustration the neck and stand are formed integrally in one casting, preferably from aluminium or an aluminium alloy, and are shown in section. A compact arrangement of the kind shown on the left is very suitable for mounting in a compartment of a cabinet type of wireless receiver.—*July 21st*, 1924.

CRANES AND CONVEYORS.

218,775. April 25th, 1923.—Improvements in or relating to Lifting Appliances and the like, James Wilson Martin, of No. 1, Beech-grove, Longsight, Manchester.

This invention relates to worm-driven lifting appliances, and consists in the provision of a double drive for the worm wheel without the provision of compensating levers. In the drawing A represents a frame which carries the whole of the gearing.

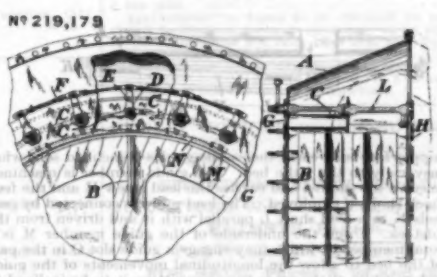


B is the lifting or chain wheel, which is carried by and fixed to the shaft C, on which is also fixed the worm wheel D, actuated by the worm E on the shaft F. On this shaft the hand chain wheel H and pinion J are also fixed, the latter gearing into pinion K, which is fixed to and drives the additional worm L gearing into and actuating the worm wheel D, and which provides additional safety.—*July 17th*, 1924.

MEASURING AND TESTING INSTRUMENTS.

219,179. August 1st, 1923.—Improvements in Air Brake Dynamometer Engine Power-testing Mechanism, Armstrong Siddeley Motors, Limited, Frederick Robertson Smith, and Bernard William Shilson, all of Armstrong Siddeley Works, Park Side, Coventry, Warwickshire.

This invention relates to air brake dynamometer engine power-testing mechanism of the type in which the air brake is enclosed in a casing and the air delivered from the casing is directed upon either the engine or a radiator for cooling purposes. Inside the casing there is a ring of blades, each separately pivoted. The positions of the blades are adjustable, so as to vary the power absorbed. When the blades are set in the position in which they are concentric with the axis of rotation, they completely pre-



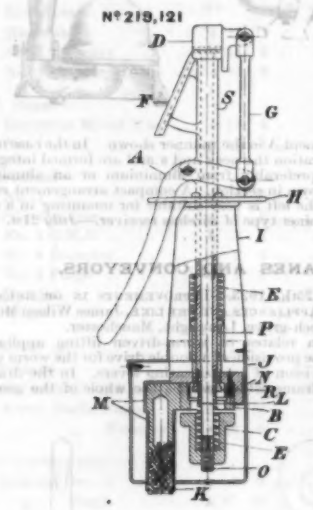
vent any delivery of air. By moving the blades separately or in groups or simultaneously, so that they provide increasingly wide apertures, an increasingly great amount of air is passed and more power is absorbed. With certain sizes of engine and air brake of this kind, there is difficulty at certain speeds in obtaining sufficient air for cooling purposes, although the power absorbed may be very high, and it is the object of this invention to provide means whereby the delivery under such conditions may be increased without affecting the power absorption, so that the

plant can be used more efficiently as a fan or blower for cooling purposes. The casing is shown at A, and part of one of the rotating paddles of the fan at B. In addition to travelling round inside the casing the air flows in the direction of the arrows. Concentrically arranged around the fan is a ring of blades C, which are balanced about their pivots D, and are provided with arms E, which are coupled together by links F. Each blade, instead of extending from one wall G of the casing to the other H, is divided into two parts C L, though there may be more than two parts, and the left-hand blade parts are all interconnected by the links F, so that they are all simultaneously controlled, and the same applies to the right-hand blade parts which have arms M and links N.—*July 24th*, 1924.

MACHINE TOOLS AND SHOP APPLIANCES.

219,121. May 14th, 1923.—Improved Type of Arc-welding Holder, Thomas Charles Winfield, 28, The Avenue, Acocks Green, Birmingham, and Joseph Clifford Rea, 20, Sarehole-road, Hall Green, Birmingham.

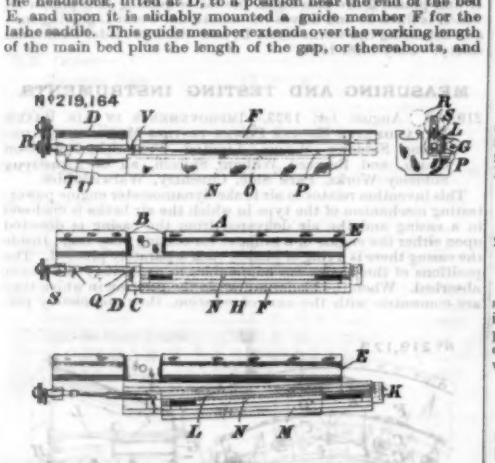
This invention relates to an improved type of holder for electrodes used in electric arc welding, whereby the holder is open circuited when not fitted with an electrode, and can safely be left about without causing fusion with other metals of opposite polarity. It is also automatically locked when in circuit for welding, and therefore no breaking of the contacts can take place if the lever grip be released, as the operator does



not need to use the grip except for putting in or taking out an electrode. A is an insulated lever for operating the switch contacts B and C, O is a metal stem connecting with jaws D, G a connecting-rod, E are springs to ensure good contact which vary in compression according to size of electrode used, F is a small metal shield to protect the stem S, K a cable sweated into B providing the live side of the switch, P a sliding bush carrying an insulated collar N, H L M I are insulated parts, R is an adjusting nut holding the sliding bush P in position, and J an insulated cup covering the switch parts.—*July 24th*, 1924.

219,164. July 9th, 1923.—Improvements in Lathe Beds, Richard Edgar Holbrook, of 44, Martin-street, Stratford, London, E. 15.

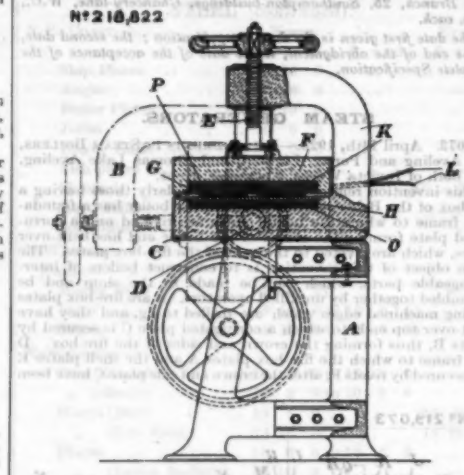
This invention relates to lathe beds, and it has for its object to provide a construction which will ensure ample support for the lathe saddle when operating upon work situated in the gap, and will also possess certain other advantages. The main portion A of the lathe bed may be of any usual type, and if preferred it may be provided with a longer gap B than usual, and it can be filled in the ordinary manner by a bridge piece when the gap is not in use. At the front side of the bed is an offset portion C, which has machined upper edges D parallel with the main part of the bed, but at a substantially lower level. This offset portion extends from the end of the gap B nearest the headstock, fitted at D, to a position near the end of the bed E, and upon it is slidably mounted a guide member F for the lathe saddle. This guide member extends over the working length of the main bed plus the length of the gap, or thereabouts, and



its upper face may carry the saddle guides G inclined somewhat transversely to the lathe bed. The guide member is machined to receive the saddle, and carries the lead screw H and the feed or back shaft, if employed. The lead screw is connected by gear wheels K to a feed shaft L parallel with it and driven from the headstock. Upon the underside of the guide member M is a pivotal member N, which may engage a guide slot O in the part P of the bed to allow the longitudinal movements of the guide member, while at the same time permitting it to be inclined to the axis of the lathe. This permits of taper turning without the inaccuracies which ordinarily arise from offsetting the tailstock of a la he, and also permits adjustments to be made with considerable accuracy by providing index marks Q at a considerable distance from the pivot, *i.e.*, at the end of the guide member. To permit the lead and feed screws H and L to be operated from the main headstock through the usual change gears R, mounted upon a quadrant plate S, a telescopic connection U is provided in the transmission to permit of the endwise movement of the guide member F, as well as universal joints V to provide for the angular movements of the guide member.—*July 24th*, 1924.

218,822. June 19th, 1923.—Method and Machine for Tempering Saw Blades, Plane Knives and Similar Tools, Paul Hustadt and Karl Hustadt, both of No. 57 Hohenbrückerstrasse, Remscheid-Hasten, Germany.

In the stationary frame A a three-armed bow B connected with the lower pressing plate C is rotatably mounted. In this bow-shaped frame B a screw spindle E is guided, and is adapted to be screwed up and down with the aid of the hand. The top plate F is fixed on the lower end of the screw spindle, so that it can be pressed upon the lower plate C when the hand wheel is

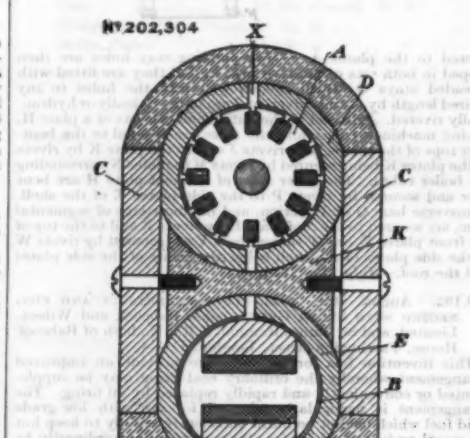


rotated. The tool G—for instance, a circular saw blade—to be tempered is placed between the two plates C and F. In these plates electric heating spirals H and K are embedded. The heating spirals embedded in the plates C and F are covered by the heating plates proper O and P, which act upon the tool. An ampère-meter is inserted in the circuit formed by the wires L, and serves to ensure the maintenance of a uniform temperature for the tempering. A pyrometer, which may be connected with a millivolt-meter is also provided.—*July 17th*, 1924.

MOTOR CARS AND ROAD TRAFFIC.

202,304.—August 4th, 1923.—Improvements in Dynamo-electric Machines, Robert Bosch Aktiengesellschaft, of 4, Militarstrasse Stuttgart.

This specification describes a combined lighting generator and magneto. The armature A of the generator runs between pole shoes D. The magnets are shown at C. Between the pole

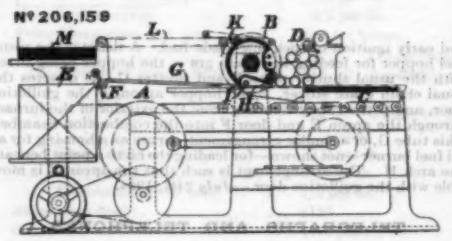


shoes D there is a small gap X. The ignition generator B is fixed to a carrier K, and the magnets C also serve to provide the field for this generator. Gaps are also formed in the pole shoes E, as shown at H.—*July 17th*, 1924.

MISCELLANEOUS.

206,159. October 26th, 1923.—Improvements in and relating to Power Printing Presses, Rockstroh-Werke Aktiengesellschaft, of Heidenau, near Dresden.

An automatic sheet feed mechanism is incorporated with a stop press of the usual design, having a reciprocating bed and an impression cylinder revolving always in the same direction, the provision of the sheet feeder entailing no departure from this design. The sheet is fed to the bottom of the cylinder. In cases where this has been done heretofore in stop presses, the printed



sheet has sometimes been delivered to rollers or bands at the opposite side of the cylinder, and sometimes it has been guided upwards along an inclined path, and then deflected towards the opposite side, in a manner which necessitates slow running of the machine, and interfered with access to the inking mechanism and manipulation thereof. According to this invention, the delivery apparatus is arranged directly above the automatic feeder, in such relation to the printing cylinder that the printed sheet is delivered along a path substantially level with the top of the cylinder, and in the opposite direction to that in which the sheet was fed in. In the drawing, A represents the frame, B the cylinder, C the reciprocating bed, and D the inking mechanism. The top sheet on the pile E is picked up by some device of known type, and moved to the feed roller F, which feeds it on to the table G. The surface of the latter is in a plane approximately tangential to the bottom H of the cylinder, and the sheet is seized by the grippers I of the cylinder. During the rotation of the cylinder, as indicated by the arrow, and the movement of the bed, the sheet is printed, and before the rotation is completed the sheet, with the print facing upwards, is fed across the bridge K on to the conveyor L, to the pile M. By arranging the delivery substantially level with the top of the cylinder, and all in a rectilinear path in the opposite direction to the feeding in, the design is rendered very simple and convenient.—*July 17th*, 1924.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

THURSDAY AND FRIDAY, SEPTEMBER 4TH AND 5TH.

Iron and Steel Institute.—British Empire Exhibition, Wembley. Autumn meeting. For programme see page 104.

FRIDAY TO SATURDAY, SEPTEMBER 5TH TO 27TH.

Machine Tool and Engineering Exhibition.—At Olympia. 10.30 a.m. (10 a.m. Saturdays).

SATURDAY, SEPTEMBER 6TH.

Institute of British Foundrymen.—Visit to the Grappe hall Works of the Richmond Gas Stove and Meter Company, Limited, near Warrington. 3.15 p.m.

MONDAY TO THURSDAY, SEPTEMBER 8TH TO 11TH.

Institute of Metals.—Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1. Autumn meeting. For programme see page 132.

TUESDAY, SEPTEMBER 9TH.

Institute of Marine Engineers.—85/88, The Minories, Tower Hill, London, E. 1. "The Measurement of Pressure," by Mr. J. L. Hodgson. 6.30 p.m.

TUESDAY AND WEDNESDAY, SEPTEMBER 16TH AND 17TH.

Institution of Public Lighting Engineers and Superintendents. Annual meeting in Glasgow. For programme see page 181.

THURSDAY, SEPTEMBER 18TH.

Institution of Municipal and County Engineers.—Town Hall, Mansfield. East Midland District meeting. 10.30 a.m.

TUESDAY, SEPTEMBER 23RD.

Institute of Marine Engineers.—85/88, The Minories, Tower Hill, London, E. 1. "An Engineer's Life in Eastern Oilfields," by Mr. E. B. Seymour Norton. 6.30 p.m.

CONTRACTS.

The Becco Engineering and Chemical Company, Limited, London, informs us that it has received two repeat orders from the Gas Light and Coke Company for water-softening plants, to be installed at Beckton (480,000 gallons per day), and Nine Elms (108,000 gallons per day).

The Hamworthy Engineering Company, Limited, of 76, Victoria-street, Westminster, S.W. 1, London, informs us that it has supplied two of its motor-driven air compressors, each of 170 cubic feet capacity, direct-coupled to 25 brake horse-power electric motors, to the House of Commons.

The Westinghouse Brake and Saxby Signal Company, Limited, of 82, York-road, King's Cross, London, N.1, has received an order from the Collins Green Colliery Company, Limited, for electro-pneumatic safety appliances at its No. 1 Bold Pit comprising two sets completely interlocked air lock door control gear, tub retarders for running-off side of pit top, scotch blocks for holding tubs in front of pit top, and point operating cylinders for control of the diverging roads at the running-on side of the pit.

The International Combustion Engineering Corporation of New York, which is an associated company of the Vickers and International Combustion Engineering, Limited, London, received the following orders for Lopulco equipments during the month of June:—Narragansett Electric Lighting Company, with six boilers; St. Joseph Lead Company, Rivermines, with two 1000 horse-power Heine boilers; Alleghany Steel Company, Pittsburg, with two 760 horse-power Stirling boilers.

The Vickers and International Combustion Engineering, Limited, of Africa House, Kingsway, London, W.C. 2, has received an order for a complete pulverised fuel installation for the power station of the County Borough of Derby. The plant will consist of two Babcock and Wilcox water-tube boilers to give steam at 300 lb. per square inch superheated to 750 deg. Fah.; each boiler having a Lopulco combustion chamber with water screen and passages inside the walls for preheating the air.

American Institute of Mining and Metallurgical Engineers.—We are asked to announce that the one hundred and thirtieth meeting of the American Institute of Mining and Metallurgical Engineers will be held at Birmingham, Alabama, on October 13th, 14th and 15th next. The annual tour of the Society will start from Washington on October 7th in a special train of Pullman cars, in which the party will live until the 17th inst., saving for the time spent in Birmingham. The following places will be visited, in addition to excursions made from Birmingham:—The Shenandoah Valley, with its caverns and grottoes; Bluefield and the Pocahontas coalfield; the Valley of the Holston River and the Mascot Mines of the American Zinc Company of Tennessee; Copperhill and Ducktown, for the mines of the Tennessee Copper Company and of the Ducktown Copper, Sulphur and Iron Company; the national parks in the vicinity of Chattanooga; and Roanoke to view a section of the Blue Ridge Mountains.